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ORIGINAL MEMOIRS.

THE VALUE OF THE DIFFERENTIAL LEUCOCYTE COUNT IN ACUTE SURGICAL DISEASES.[1]

BY CHARLES LANGDON GIBSON, M.D.,

OF NEW YORK,

Attending Surgeon to St. Luke's Hospital.

THE systematic examination of the various elements comprising the white cells of the blood, the so-called "differential count," has been extensively used in the last two years in the surgical clinics of this city. These researches have been particularly on the increase of the polynuclear cells in inflammatory conditions, especially in disease of the appendix and its sequelæ.

Material for this paper has been furnished chiefly by blood examinations made in my service at St. Luke's Hospital during the year 1905. A very few examinations date back to 1904; and by the kind courtesy of my colleagues Dr. Robert Abbe and Dr. Farquhar Curtis, enough counts have been added to raise the number to about two hundred examinations.

The differential counts are made by the *personnel* of the Pathological Laboratory of St. Luke's Hospital, which is admirably conducted by Professor F. C. Wood; and there is every

[1] Read before the New York Surgical Society, January 24, 1906.

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reason to believe that these examinations are made in the most approved manner, and that they are thoroughly reliable.

Although so much material must now be available, little or no attempt has as yet been made by the surgeon to draw practical deductions from such data.

The most satisfactory contribution to the subject is the paper of Dr. F. E. Sondern, "The Present Status of Blood Examinations in Surgical Diagnosis,"[2] which puts the subject on a thoroughly practical basis.

The reason so little authoritative comment on the value of this method has been made is doubtless a more or less general impression that the findings are merely an elaboration of the leucocyte count rather than, as I hope to demonstrate, a quite different and much more important element.

When the differential count first began to attract interest, the value of the ordinary leucocyte count had become much discredited by many, perhaps most, surgeons. This distrust was certainly felt by the writer, who had ceased to pay more than a minimum of attention to such findings.

Even as recently as September, 1905, one gets from the report of the First International Congress of Surgery, at which examination of the blood was made a major subject, nothing of the importance of the new investigation, it being mentioned only casually, and with no attempt to emphasize its special features.

Just as the original leucocyte count had its pitfalls, the differential count, it must be admitted, has its individual drawbacks. It needs, even more than the older method, a considerable knowledge of the subject and ability to interpret judicially the several pathological variations. This knowledge, however, can be applied much more surely, with fewer mistakes and far greater positive and helpful results.

The value of this method depends not on the significance of any given quantities, X or Y representing the number of the leucocytes or of the polynuclears. It does not depend at all

[2] Medical Record, March 25, 1905.

on the absolute percentage of the polynuclear cells, a method almost as valueless as the leucocyte count alone, but on the *relative proportion* of the polynuclear cells to the total leucocytosis.

To understand this relation, it is necessary to consider very briefly some elementary facts and also the standard which the writer has adopted in studying the results of the differential count.

Normal Leucocytosis.—Variable quantity, influenced by age, variations in habit, time of day, food, exercise, etc. Average varies, according to different authors. Sondern gives the average as 6700. The writer has thought it wise to consider 10,000 as the extreme limit of ordinary normal leucocytosis, believing that this estimate will correct errors of idiosyncrasy, etc.

Hyperleucocytosis, then, would mean counts in excess of 10,000.

Hypoleucocytosis is still harder to determine and without special reasons should not be so considered except distinctly under 5000, with a considerable reserve for personal idiosyncrasies. The surgeon is generally more interested,—certainly in acute inflammations,—in an *increase* rather than a decrease of leucocytosis.

Leucocytosis in inflammation is an index of reaction rather than of the absolute severity of the particular kind of infection.

As we shall see later, there are a number of fatal cases with a distinct lowering of the leucocytosis.

Sondern says: " Leucocytosis is largely dependent on body resistance towards infection, and therefore the degree of increase can be no guide to the intensity of the pathological process. Good resistance will produce pronounced leucocytosis even in slight infections, and poor resistance but little leucocytosis in slight infections and possibly none at all in grave infections. No adequate clinical method exists by which this body resistance can be determined with sufficient accuracy to apply it as a factor to the leucocyte count; and this is the key

to the disappointment encountered by the surgeon in utilizing these counts in diagnosis."

What is the normal proportion of polynuclear cells? The normal ratio is again estimated differently by various authors. Sondern's average is 68 per cent. Most authorities put it somewhat higher. Von Lembeck, quoted by Cabot, puts it at 70 to 80.

The writer has thought it wise, as in the case of the leucocyte count, to adopt the rather higher average corresponding perhaps more accurately to what is called hyperleucocytosis, and has adopted 75 per cent. as a working average.

In infancy there is a very marked diminution of the proportion of polynuclear cells, said to be from 28 to 40 per cent. The writer's cases show in infants with pathological conditions a strikingly low polynuclear count,—*e.g.*, child of six weeks, fatal intestinal obstruction, total leucocytosis 16,200 per cent., polynuclear cells, 14. Child 1 year, acute otitis media, total leucocytosis 13,300 per cent.; polynuclear cells, 31.

The Behavior of the Polynuclear Cells; Cells in Acute Inflammatory Conditions.—Generally speaking, there is a rise in the percentage of the polynuclears which is a fair index of the severity of the process, but it must be strongly emphasized that it is *per se* far from being an absolute guide; for if we should rely *alone* on the increase of the polynuclear cells, we should have but little more information than was furnished by the older method. For it must be remembered that we may have,—even though it be rare,—a very high percentage of polynuclear cells without a very serious or fatal result. Sondern says in his experience more than 94.5 was always fatal.

Personal experience furnishes a notable exception. Man, age 74, advanced tuberculosis of the testicle; per cent. polynuclear, 97.5. A case of gangrenous appendix, very ill, was saved by operation; polynuclear 94.5. A case of "catarrhal appendicitis," recovering without operation; leucocytosis, 20,600; polynuclear, per cent., 94.

As a matter of fact, a very high percentage of polynuclear

cells (infants not computed) is not the rule in fatal cases as the average in these recorded cases was: Total leucocytosis of 13,000, per cent. polynuclears, 82.9; showing a disproportion of five counts in the "standard" chart.

Some instances of low polynuclear per cent. in fatal cases: Gangrene of the lung, 57 per cent.; pyemia, 67; general peritonitis, 69.

Dr. Sondern's findings are: "In adults a purulent exudate or a gangrenous process is decidely uncommon with less than 80 per cent. of polynuclear cells, and the probability of their presence increases with their percentage."

While admittedly true, this statement has too many exceptions not to call for some special comment, as may be noted from the following cases: General peritonitis, 69 per cent.; general peritonitis, 75 (two cases) appendicular abscess, 77; pyosalpinx, 76; pyosalpinx, 75½; gangrene of skin, 59; gangrene of leg, 75; abscess of lung, 57; acute pelvic abscess, 66.5; ischiorectal abscess, 77; pyemia, 67; perinephritic abscess, 72; acute suppurative nephritis, (three counts,) 68, 55, 62.

So that we must look further for some value inherent to the polynuclear count than the mere degree which it may attain. Its real value in the writer's judgment is to be found in another and distinct feature, viz., *the relative disproportion of the polynuclear percentage to the total leucocytosis.* This is the feature which Dr. Sondern has so clearly pointed out, and constitutes the chief topic of the present contribution.

In this matter, the question of body resistance, necessarily conjectural, must be taken into account; but it is probably more clearly defined by this disproportion than by any means at present in our command.

The writer's experience and observation lead him to believe that with a moderate use of the total leucocytosis there should be in favorable cases a moderate rise only of the polynuclear cells, showing that the infection is localized and absorption is limited.

On the other hand, if there is only a moderate leucocytosis

with a *notable increase* in the polynuclear cells, it indicates almost unquestionably that there is either a severer form of lesion or that there is less resistance to absorption, or that both of these conditions exist.

As examples of good resistance (see chart) the following examples may be quoted:

	Leucocytosis.	Polynuclear, percent.	
1. Appendicular abscess,.....	14,000	77	
2. Appendicular abscess,.....	18,000	78½	
3. Acute appendix,.....	20,000	78	
While as examples of a severe lesion (note steep line of this second group rising from the leucocyte side of the chart to the polynuclear side):			
4. Acute gangrenous appendix.....	4400	81	Died
5. Acute appendix and general peritonitis, ...	10,600	83	"
6. Intestinal obstruction,.....	7400	81.5	"
7. Septic endometritis, general peritonitis, ...	17,800	97.5	"
8. Gangrenous appendix,.....	9500	94.5	Cured
9. Appendicitis, general peritonitis,....	13,200	86	Died
10. Septic endometritis, general peritonitis, ...	14,000	91.5	"

This *disproportionate* increase of the polynuclears is on the whole more reliable than any of the other data, and has served greatly to influence the writer's work in the past year. The exceptions have been few; in no case has he actually been led astray, though occasionally the lesion has been of lesser severity than anticipated. There is, however, a good deal to be said on this last point, particularly on the important subject of appendicitis. We operate now usually so promptly that we find the lesions relatively less advanced than formerly, while some of these seemingly mild processes may potentially have the worst possibilities. My colleague, Dr. Curtis, for instance, informs me that he removed a rather mild-looking appendix that was productive of very acute symptoms and a high differential count, but inoculations from the contents of the appendix yielded a virulent culture of streptococci.

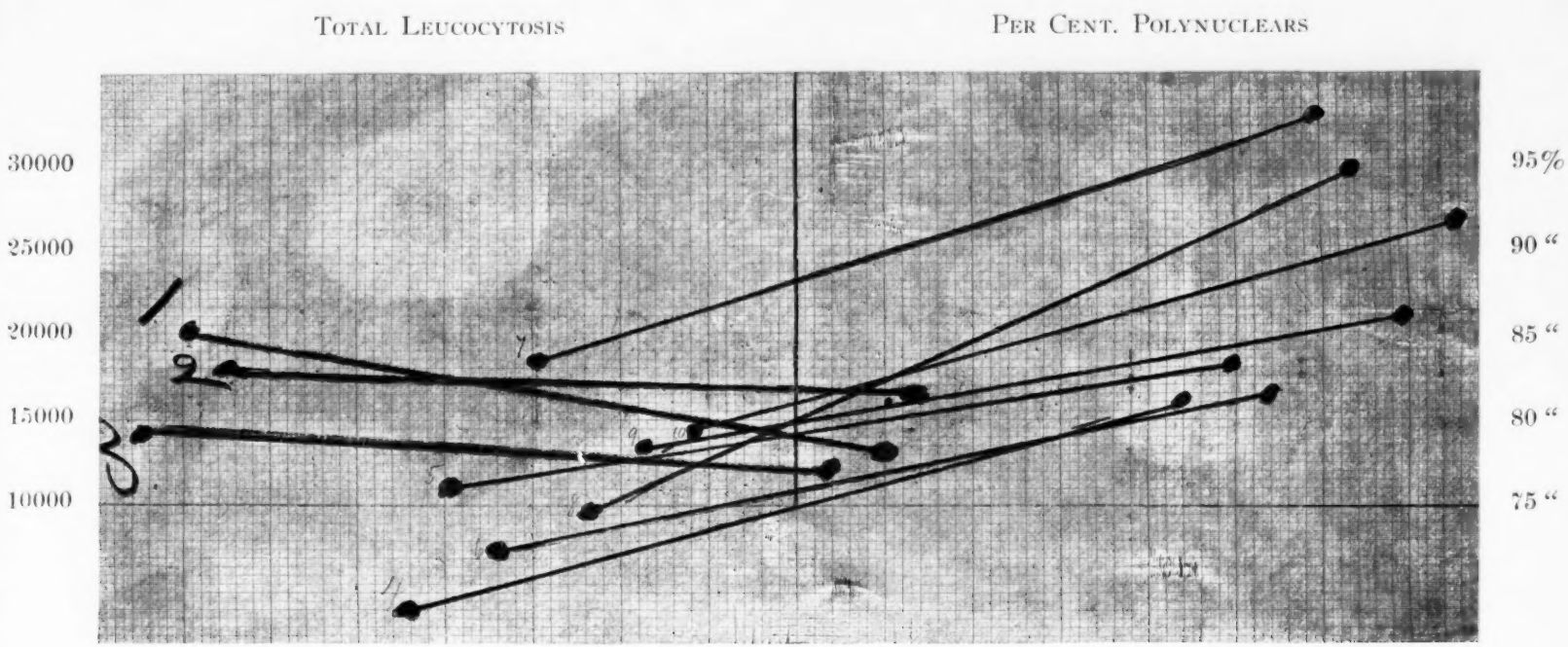
Total Leucocytosis
Per Cent. Polynuclears
30000
25000
20000
15000
10000
95%
90 "
85 "
80 "
75 "
1
2
3
4
5
6
7

Chart 1.

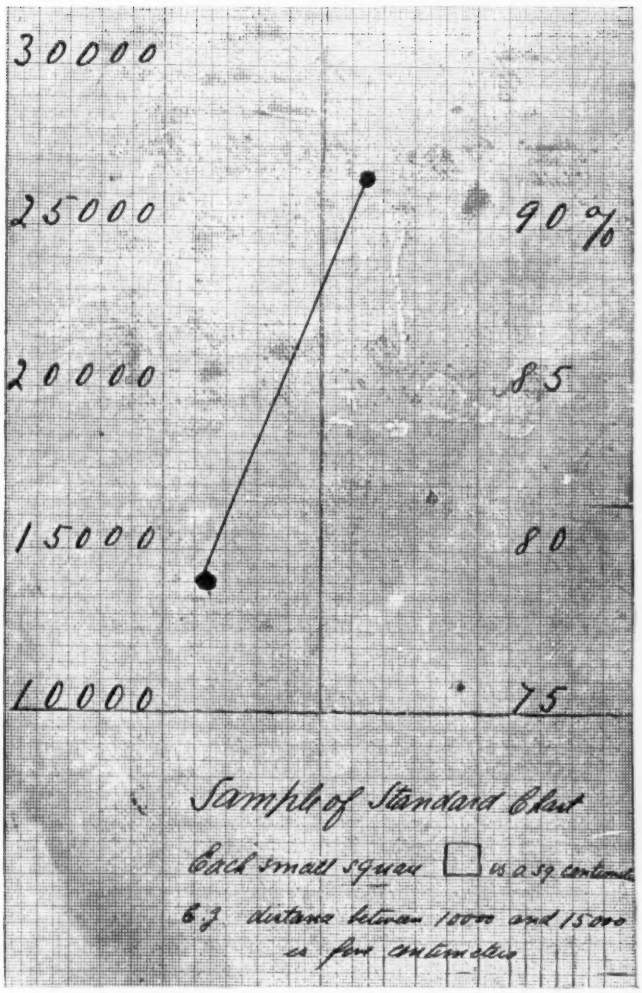
30000
25000
20000
15000
10000
90 %
85
80
75
Sample of Standard Chart
Each small square ☐ is a sq centimeter
63 distance between 10000 and 15000
is four centimeters

CHART 2.

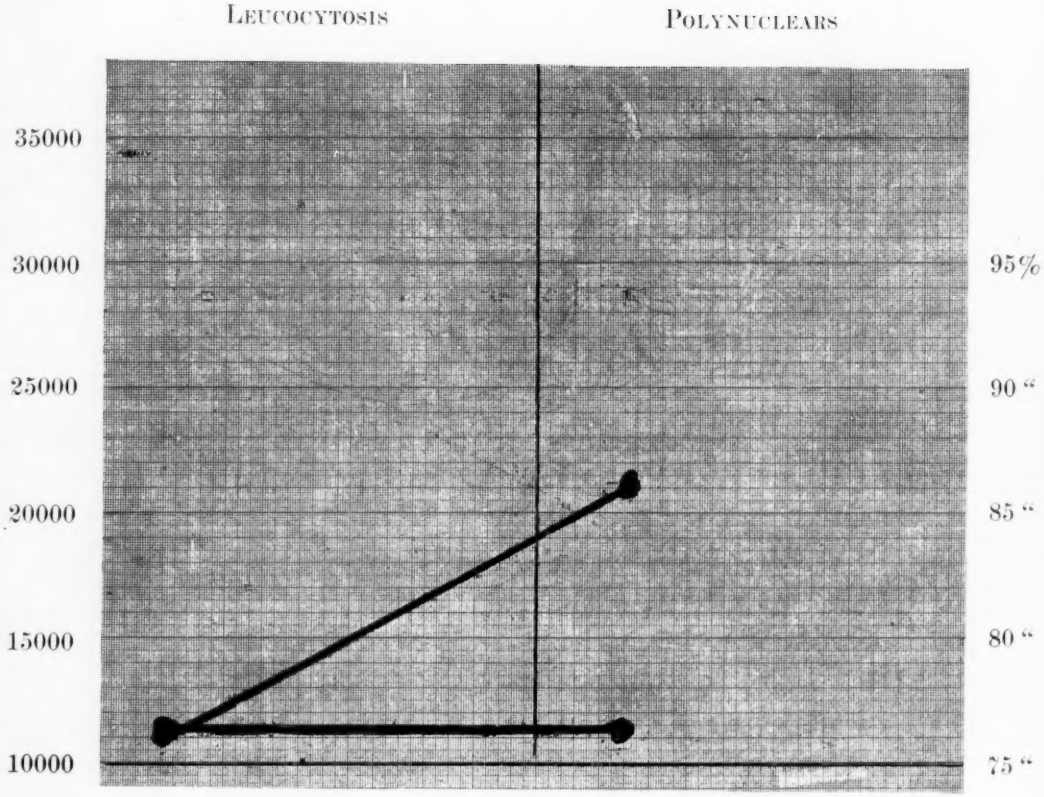
Leucocytosis
Polynuclears
35000
30000
25000
20000
15000
10000
95%
90 "
85 "
80 "
75 "

Chart 3.

What shall be the standard by which we shall gauge various degress of disproportion between the leucocyte count and the percentage of polynuclear cells? As we have no definite means of measuring body resistance, it is necessary in the present state of our knowledge to resort to avowedly arbitrary standards.

It has seemed to the writer that in inflammations which are well resisted, the polynuclear cells are increased approximately one degree for every one thousand of the total leucocytosis above ten thousand. Starting with such a basis, experimental charts have been worked out and the results seem on the whole to show that such a standard forms a very good working basis for the measurements which have been adopted by the writer. (Chart II.)

Description of the Standard Chart.—The chart is divided into units of one centimetre allowing an easy and practical computation of the results. A horizontal base-line is drawn as the starting point of the pathological leucocytosis of ten thousand on the left-hand side, while the other or right-hand end of the base-line corresponds with the index of 75 per cent. polynuclear cells, the limit more or less arbitrarily chosen. Variations in these proportions are indicated by making a dot at the proper level of the left-hand or leucocytosis side of the chart, while a similar dot at the proper level of its percentage is made on the polynuclear side of the chart. For purposes of convenience these two dots are connected by a straight line. The vertical distance between the two dots will represent in the accepted counts (one centimetre) the disproportion between the two counts. (Chart III.)

E. g.—suppose on the left a dot indicating a leucocyte count of 11,000 and on the right a dot indicating 76 per cent. polynuclear cells, the result would be indicated by a line which would be absolutely horizontal, and would be indicative of a just proportion between the two elements of the count.

If, however, with the same leucocytosis of 11,000 there were a polynuclear increase to 86 per cent. the line connecting

these two points would have a steep rise from left to right and measurement of the vertical distance between these two points would give ten centimetres or ten units.

Thus we have something definite to compute, and we could speak of a five unit or a ten unit or a fifteen unit disproportionate increase or decrease of the polynuclear cells.

Such a chart moreover is particularly useful in continued examinations from day to day, as the fluctuations can be readily read and expressed in definite counts, such accurate comparisons being lacking heretofore.

If a large number of observers would collect extensive data by using such a standard chart, utilizing these units to record their findings we might hope eventually to strike working averages and standards on which to base future observations.

The writer feels that it would be presumptuous and unsafe to attempt as yet to lay down any rules from his limited findings with such a chart.

He hopes, however, that others may be encouraged to adopt the standard which is hereby tentatively offered, and, it is hoped, improve on it.

Speaking very generally and with considerable reserve, the writer attaches already considerable significance to the findings which some of these charts have shown.

If the line connecting the levels of the leucocyte count and the polynuclear count runs pretty nearly horizontal, whether up or down, only 2 to 4 units difference, it indicates a lesion that whether severe or not, is well borne and therefore of a good prognosis.

Lines running *upward* from the leucocyte side towards the polynuclear indicate in general a rather severer lesion and less resistance. If the interval between the two points is considerable, say ten or more units, we are quite sure to have a pretty severe lesion. The majority (about $^2/_3$) of total cases of all kinds show a rising line, and as we shall see later in such a condition as appendicitis, fatal cases have *all* a rising line. (Chart IV.)

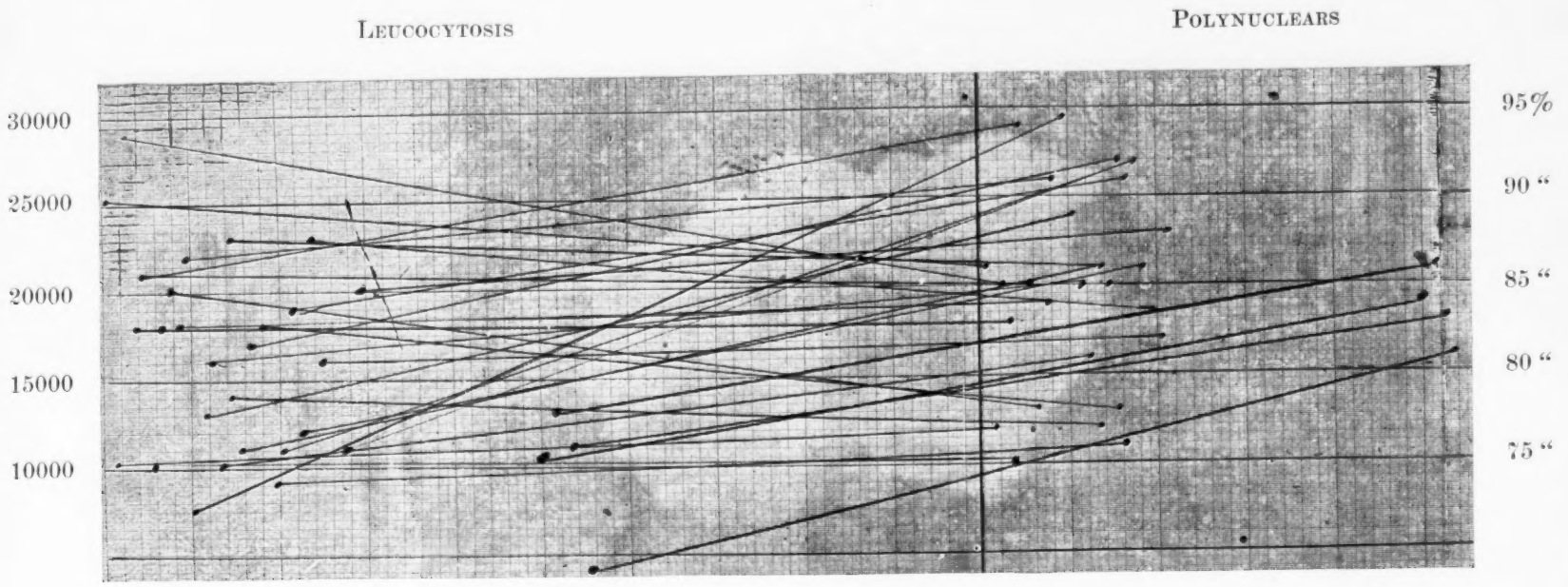

Chart 4.—Acute Appendicitis.

THE DIFFERENTIAL COUNT IN SPECIAL CONDITIONS.

Appendicitis.—In twenty acute cases a *distinct* disproportionate increase of the polynuclears indicated by a *rising* line was manifest.

In two cases the line was very nearly horizontal, showing a good balance between the two elements.

In three cases there was a distinct downward tendency of the line, showing preponderance of leucocytes.

These results seem to show a positive value for the differential blood-count as estimated by the standard chart.

There was one exception: Mild case of catarrhal appendicitis, allowed to convalesce without operation. A single examination showed leucocytosis 24,600; polynuclear, 94 per cent.; giving a rise of four units.

ALL the severer lesions, those with gangrene of the appendix or progressive peritonitis, and *all* the fatal cases, showed a *rising* line on the standard chart, while all the cases indicated by a falling line were distinctly mild types such as well-defined "safe" abscesses with little febrile or constitutional disturbances. As it is in the severer cases, particularly those in which the initial symptoms are obscure or perplexing, that we can least afford to make mistakes, the great value of the polynuclear increase is evident, as the findings on these cases will hardly ever lead us astray.

A case of this nature first definitely called my attention to the value of the method in question:

Man 28, who for twenty-four hours had had a chain of acute abdominal symptoms, obstinate vomiting, general abdominal pain, moderate rise of temperature and pulse; looked sick. Examination of the abdomen quite negative as regards ordinary signs of appendicitis. A little tenderness just above the pubes was noted, but it was said to be habitual. Rectal examination elicited some tenderness on pressure against the posterior wall.

Differential count by Dr. Sondern: Leucocytosis, 22,800;

polynuclears 88 per cent. When seen six hours later, general remission of all symptoms, felt and looked better.

Strengthened by Dr. Sondern's personally expressed opinion. I had made a diagnosis of gangrenous appendix which was probably permanently fixed in the pelvis. The patient was immediately taken to St. Luke's Hospital, but two of the best consultants failing to confirm my views; operation was deferred for twenty-four hours, by which time the condition was obvious. Operation showed great meteorism, general reddening of the intestine, a little turbid serum and finally a gangrenous appendix in the pelvis. Death from progressive peritonitis.

The above experience, so far as the correctness of the findings is concerned, has been frequently repeated, and did space allow many similarly impressive instances could be cited.

The importance of a disproportionate increase of the polynuclears (rising line on the chart) particularly if progressive, cannot be overrated, and those wilfully disregarding such evidence are perhaps not exhausting all resources of diagnosis.

If one examination in a threatening case of appendix shows for example 15,000 leucocytes and 85 per cent. polynuclears, a difference of five units by the "standard" chart, and a second later examination shows the same leucocytosis with a *rise* of the polynuclears to 87 per cent., the condition must be regarded as considerably worse, both as regards the increasing severity of the lesion and the diminishing ability to withstand it.

Chronic Appendicitis.—These cases of interval operation showed on the whole little leucocytosis and practically no disproportion on the chart, viz.: Five cases showed a falling line on the chart; five cases showed a stationary line or an insignificant rise.

Female Genitalia.—The differential in pyosalpinx:

	Leucocytosis.	Polynuclear, percent.
1.	22,300	87
2.	12,000	76
3.	8700	75.5

	Leucocytosis.	Polynuclear, percent.	
4.	11,000	82.5	
5.	15,000	76.5	
6.	8000	66.5	
7.	13,600	81.5	
8.	16,400	88	
Average percent. polynuclear,		77.5	
Septic endometritis,	17,800	97.5	Died
Septic endometritis,	12,000	75	Cured
Septic endometritis, general peritonitis.	21,800	91.5	Died

The differential count in pyosalpinx was absolutely consistent. The chronic cases with little temperature showed an average of 70–75 per cent., the acute cases a little over 80 per cent. None reached any of the extreme ranges which would have been inconsistent with such a well-limited inflammation, while in the case of septic endometritis peritonitis there was attained the maximum polynuclear count 97½ per cent., which with a leucocytosis of 17,800, gives a disproportionate increase of polynuclears of 16½ units, which speaks eloquently for the prognostic significance of these examinations and the method of computing these results.

Intestinal Obstruction and Cases of General Peritonitis.—Eight cases; one recovery. Average disproportionate use of polynuclears was $7^{3}/_{10}$ per cent. a high count whose value is self-evident.

Tuberculosis.—It is stated by some that there is a decrease, absolute and relative, of the polynuclear cells in tuberculosis. The writer's findings do not generally substantiate such views, the percentage of the polynuclears being generally a rising one.

	Leucocytosis.	Polynuclear, percent.
Tuberculosis of the peritoneum	8,800	86
Tuberculosis of the peritoneum	1,900	82
Tuberculosis of the spine	22,000	81
Tuberculosis of the hip	3,200	68
Tuberculosis of the kidney	23,200	72.5
Tuberculosis of the kidney	21,000	84
Tuberculosis of the testicle	23,000	97½

This last polynuclear increase of 97½ is the largest occurring in the series, it being also observed in a case of fatal septic endometritis. Only once has the author noted a higher percentage, a case of suppurative meningitis, 99½, quoted by Cabot.

Biliary Tract.—Observations as regards reaction to gallstones without infection showed only negative data, while in two fatal cases of empyema of the gall-bladder there were rises on the standard chart of four units in one case and five and a-half in another case, those findings being particularly significant. The patient was extremely ill. The huge suppurating gall-bladder was easily and quickly shelled out of its bed without contamination of the wound, which was liberally packed and left open. The septic manifestations, however, continued to increase, although an autopsy disclosed an irreproachable condition of the site of the operative manipulation. In this case the increased proportion of the polynuclears 91½, with a total leucocytosis of 21,000, must be interpreted as a significant warning of the intensity of the necessarily fatal septic absorption.

There is in most cases a postoperative or, more properly speaking, postanesthetic temporary leucocytosis. While the data at hand are insufficient to warrant any generalization, an impression was gained that the polynuclears behaved quite consistently in such cases, rising more or less proportionately with the leucocytosis and subsiding likewise.

In the convalescence after operation the relative differential count always proved itself of value, more particularly after abdominal section with wound infection, the differential count showing a rise of the polynuclears consistent with the temporary leucocytosis rather than a disproportionate increase which would have been suggestive of a progressive peritonitis.

It was of value in several cases of miscarriage or abortion in confirming the belief that we were dealing with the effects of the retention of the products of gestation rather than with septic infection.

It was of value several times, by the presence of a very low polynuclear (28 in one instance) in calling our attention or confirming our suspicions as to the probability of a typhoid fever.

As regards the value of a rise in the proportion of polynuclears as indicating the existence of a typhoid perforation, the writer has no direct data. Its value has been insisted on by some, and the disproportionate rise should naturally be expected with a progressive peritonitis, which surgically does not interest as much as our intervention must anticipate the peritonitis in order to expect success.

It is probable that there may be an antemortem rise in polynuclear cells in certain conditions which should not ordinarily produce such an increase.

A moribund cancer of stomach showed leucocytosis of 7800, polynuclears of 86, a difference of 13 units on the standard chart. Moribund double hydronephrosis from sarcoma of bladder temperature 100, leucocytosis 9900, polynuclears 90, a disproportionate rise of 15 units on the standard chart.

In the case of a stricture of the urethra with a chill and a rise of temperature to 105.6, quickly subsiding without sequelæ, there was an interesting prognostic negative count of polynuclears, only 63 per cent. to 16,000 leucocytosis.

Two prostates showed interesting counts. One was very large and tender and highly suggestive of the development of an abscess. There was only 63 per cent. polynuclears, with 10,000 leucocytosis; 24 hours later there was a marked remission of all symptoms, and entire cure followed.

In the other, a large abscess was evacuated; leucocytosis, 10,000; 24 hours later there was a marked remission of all symptoms, and entire cure followed.

There were several curious observations from the usual behavior of the polynuclears to be noted, and it is probable that there was in these cases some counteracting influence for which there is at present no proper explanation:

E. G., woman, 28, with foci of multiple miliary abscesses of the kidney, cured by resection of the upper and lower lobes of the left kidney. She ran an irregular and high pyemic temperature and yet there was not in four examinations a polynuclear percentage higher than 68, the leucocytosis ranging from 7400 to 9300. On the other hand, this patient may be explained as of prognostic value and denoting that the process was not of a severe nature. Another case, of a man extremely ill with acute pyemic symptoms, which seemed to point to suppuration of the liver, showed great variations in the proportions of the polynuclears, which at no time rose above 88½, although he immediately succumbed to an exploration of the liver, which was not the site of an abscess, but showed a condition of general breaking down of the tissue.

A large number of corroborative examinations were made on persons with non-inflammatory and favorable surgical lesions, such as reducible hernia, prolapse of uterus, deformities, etc., to see if any data might be developed which would invalidate our surmises as to what constitutes normal or abnormal differential counts; but in no instance was any inconsistency noted.

This investigation has covered only the behavior of the polynuclear cells as it was thought inadvisable to consider other elements from lack of sufficient material.

Attention should be called to one property of the eosinophiles, which seems not to appear in many of the recent works on blood, namely: the increase in gonorrhœa, which was found not infrequently in these observations, in one case as high as 6 per cent. in a case of gonorrhœal rheumatism, with a latent urethral lesion.

CONCLUSIONS.

The differential blood-count and its relation to the total leucocytosis is today the most valuable diagnostic and prognostic aid in acute surgical diseases that is furnished by any of the methods of blood examination.

It is of value chiefly in indicating fairly consistently the existence of suppuration or gangrene, as evidenced by an increase of the polynuclear cells disproportionately high as compared to the total leucocytosis.

The greater the disproportion the surer are the findings, and in extreme disproportions the method has proved itself practically infallible

As the relative disproportion between the leucocytosis and the percentage of polynuclear cells is of so much more value than the findings based on a leucocyte count alone, this latter method should be abandoned in favor of the newer and more reliable procedure.

The negative findings showing no relative increase or even an actual decrease of the proportion of the polynuclear cells while of less value, shows with rare exceptions the absence of the severer forms of inflammation.

In its practical applications, the method is of more frequent value in the interpretation of the severity of the lesions of appendicitis and their sequelæ.

In order to have some standard to measure disproportion of the polynuclear percentage, it is suggested that a trial be made of the chart which is tentatively recommended under the arbitrary designation of " standard."

FIBROLIPOMA OF JAW AND NECK.

BY LEWIS W. ROSE, M.D.,
OF ROCHESTER, N. Y.

HENRY C. D., age 66, was brought to my service in the Rochester City Hospital by the ambulance, September 15, 1905. He had fallen unconscious in the street, and received a scalp wound over the right frontal region. His fall was probably due to a slight cerebral hemorrhage, from which he recovered, as he did from one two years ago.

This man is well known in Rochester, and is a familiar character on the streets. He is especially conspicuous by reason of an enormous mass on the left side of his neck, which he has always kept covered with a black silk bag. The patient states that this large, lobulated and pedunculated tumor (Fig. 1) has been gradually and continuously growing for about forty-three years. He also states that it started below the angle of the lower jaw, and was not connected with the parotid gland.

It now measures, in its largest circumference, 25 inches; around the pedicle it is 17 inches, and in length, from base to apex, about 16 inches. The skin is slightly movable over the growth in most places. It has some areas more or less adherent, due in part, probably, to the inflammatory action caused by the punctures of a needle which was used some years ago in treating the tumor by electrolysis.

In color and texture the skin resembles that of his face; the beard extends out over the growth, and hair thinly grows over most of it. The superficial veins are very large and prominent. The skin becomes stretched, tense and shiny when the tumor is not supported. This appearance is caused not only by the great weight, but also by the momentary rapid increase in size, due to the engorgement of blood within the tumor.

On palpation a lobulated, pedunculated mass is felt. It is movable about the structures of the neck at the point of attachment. Some of the lobes are quite hard, others impart a sense of elasticity, and one area is soft and apparently fluctuates. Portions of the skin are much thickened. Manipulation at times causes pain.

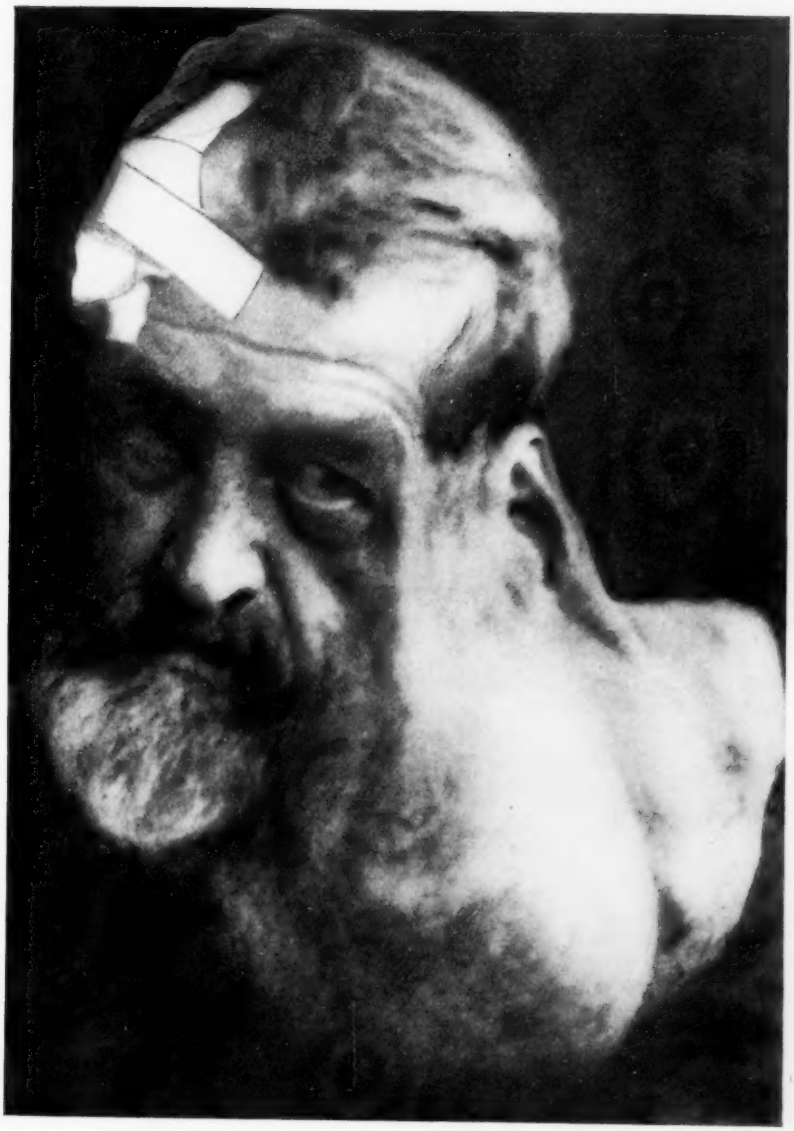

FIG. 1.—Enormous fibrolipoma of jaw and neck.

FIG. 2.—Large fibrous tumor growing from neck. Was successfully removed —Liston. From Miller's Principles of Surgery (Edinburgh) 1852.

FIG. 3—Mixed Cartilaginous Tumor—Paget. Growing from the interstitial tissue of the parotid gland (Warren. Fg. 123).

FIG. 4.—Enormous fibroma growing from left parotid region in a negress. Matas case. New Orleans Medical and Surgical Journal, February 4, 1894.

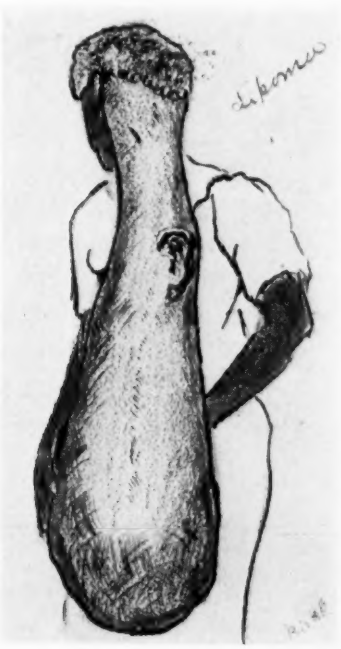

FIG 5.—Lipoma of Parietal Region. Rotter's case mentioned by Chipault in La Med. Moderne, December 11, 1895.

Some of the older writers, Muller, Rokitansky, Gluge and other German histologists, have given us the term "Mixed Lipoma," which term I think can be used to describe this growth.

Fibromata of the neck are described as being connected with the ligamentum nuchæ or vertebral periosteum; they vary in consistency, and may be either elastic or of stony hardness.

Some of the large tumors originating from the parotid gland are also described as fibroid; chondromata also have their origin from this gland.

In my case the tumor does vary in consistency, however, it did not originate from the structures mentioned. It was originally probably a simple lipoma.

That it is now a mixed lipoma may be inferred—First, from the presence of hard lobes, which hardness is due to an increase of the connective tissue stroma with fat obliteration—fibrolipoma. Second, from the presence of soft, jelly-like, and apparently fluctuating lobes—myxolipoma; this myxomatous degeneration is, according to Senn, the most frequent retrogressive metamorphosis in the stroma of these organs. Thirdly, from the apparent increase in size when this tumor hangs unsupported and the decrease in size when it is supported and slightly compressed, it is inferred that lipoma telangiectasis and also lipoma cavernosa exist.

There is no apparent calcification and it probably is not present. This form of degeneration, occasionally occurring in these tumors, arrests their growth. There never has been any arrest of development in this case. It has been a slow, continuous, and painless process.

The patient states that about forty years ago, when the tumor was small, a New York surgeon advised against its removal, as the result would probably be fatal. Since then he has not entertained the idea of surgical interference. Never until this time would he consent to be photographed, or have the case reported.

DISCISSION OF THE PLEURA IN THE TREATMENT OF CHRONIC EMPYEMA.

BY JOSEPH RANSOHOFF, M.D., F.R.C.S.(ENG.),

OF CINCINNATI, OHIO.

THE prognosis and surgical treatment of purulent pleural effusions have undergone some radical changes by reason of comparatively recent bacteriological and, it might be said, operative experiments. In accordance with the bacteriological findings, the age of the patient, and the completeness of the drainage, these cases go to a speedy cure with absolute restitution to health, or run a course that is protracted in the extreme. In some cases, chiefly of tubercular origin or of grave streptococcus infection, incision practiced at the earliest practical moment and ample for drainage may yet fail to bring about that mobilization of the lung which is the one essential to a cure. On this last point I would insist chiefly for the mental relief of practitioners who, like myself, have seen acute cases assume an almost interminable course notwithstanding the early institution of drainage.

With the operation of multiple rib resections formally introduced by Estlander in 1877, to meet a condition of seemingly permanent retraction of the lung, our concept of the curability of chronic empyema was radically changed. The various modifications of thoracoplasty by Schede, Quenu Jaboulay and others served only to make the mobilization of the chest-wall less hazardous, perhaps, and the contact of the variously fashioned flap from the chest-wall with the retracted lung easier. The Estlander operation and its modifications were based on the idea of the permanent disability of lung long bound down by adhesions to expand.

In 1893 there was elucidated a new fact regarding the functional value of lung-tissue long buried in thickened pleura

and fibrous adhesions. It was that the power to expand is not lost, and that if freed from its fetters the lung would again expand. Whom to credit with the discovery of this basic fact, which led to decortication of the lung in the modern operative treatment of empyema, it seems to me not difficult to determine. According to Terrier, Cornil made the observation in 1891. Before the French Surgical Congress of 1893 DeLorme reported on a case operated on by him in which he attempted the removal of the thickened visceral pleura. The patient suddenly died and the operation with pulmonary decortication was easily completed in the mortuary.

I may be permitted here to digress long enough to call attention to the frequency of sudden deaths during even the simplier empyema operations. I know of two such sudden deaths in this city. Probably the posture of the patient on the sound side during the operation has something to do with the frequency of sudden death during an operation that should *per se* be devoid of danger.

Without any knowledge of the observation of Terrier or DeLorme, Fowler, on October 7, 1893, operated on a case of empyema of two years' standing having a small rigid cavity, with a distinct intention to remove the scar-tissue from the diaphragm, pericardium and lung, with a view to permit the free expansion of the lung. Fowler having first performed the operation on the living, it is but right that priority should be given him by our continental friends. Whether it will be, is a question.

Decortication of the lung is but a step, although a very important one, in the operation for empyema. It cannot be considered an independent procedure. The cavities to be obliterated are usually so deeply placed and the pulmonary pleura so far from the surface that the formation of a large flap containing the soft parts and the ribs or multiple rib resection is necessary as a preliminary step to decortication. All attempts, therefore, to compare the results obtained from the

older methods of thoracoplasty with those from decortication are futile. As performed by Fowler and DeLorme, the operation consists, after sufficient exposure of the pleura has been achieved, of an incision through the thickened pleura down to the lung-tissue, from which incision the thickened pleura is dissected off, care being taken not to wound the lung. Because of the very close adhesions and the depth at which the work has to be done, this dissection *en masse* of the thickened pleura is sometimes tedious in the extreme. DeLorme's first case required one and a-half hours to complete the operation, although the cavity was less than three inches in depth and width and four inches in height.

A perusal of the relevant case reports collected within the last five years by DeLorme, Fowler, Vosswinkel and Jordan makes it evident that in many cases insurmountable difficulties are in the way of anything like an extensive decortication. One of my first cases was of this nature and from it I learned, what other operators must certainly have observed, namely, that an incision carried through the thickened pleura until the lung-tissue is reached, as is evidenced by the bluish tint in the floor of the cut, widens out rapidly and in full view, more with each respiration until the cut becomes a groove. Whether this widening of the cut is due to the expansion of the lung or to the traction of the elastic chest-wall, or to the inherent tendency of divided scar tissue under tension to retract, I am unable to say. My belief is that the last-named cause is the most potent factor, for I have made the observation that many times the gap made by the incision grows narrower for the time being during inspiration to get wider again during expiration. This may be due to the negative pressure within the lung at the time of inspiration, by reason of the greater inrush of air through the opening in the chest-wall than can enter the lung by way of the bronchus.

Where one incision carried to the lung-tissue widens into a groove, so will a second and a third, and any number that

may and can be made. Upon these principles I acted on my first case and in the rest to be reported, and devised what perhaps might be called discission of the pulmonary pleura as a modification of the operation of decortication, which I believe it may in time supplant. The special feature of the procedure consists of gridironing the pulmonary pleura with many parallel incisions removed from each other about a quarter of an inch, and of crossing these obliquely or at right angles with other parallel cuts. Little islands of thickened pleura are thus left on the surface of the expanding lung. But if the cuts have been made deep enough they shrivel in size while the discission is still in process of being completed.

A further feature towards liberating the lung is an incision cautiously carried through the length of the groove or angle of reflexion of the costal and pulmonary pleura. In large cavities the line of reflexion is, of course, not always easily found. If the incision be limited to the costal part of the gutter and carried towards the chest-wall, there is no danger of wounding large vessels or of opening the sound pleura above. The hemorrhage which attends discission is really slight and easily controlled.

Case I.—E. M., male, aged 18, of Mitchell, Ind. First examination, June 6, 1901. Patient states that ten weeks ago he was seized with pleuro-pneumonia of the left side that was followed by a purulent effusion. An incision was made on the fourteenth day and a large quantity of pus evacuated. The drainage-tube was removed after two weeks, but because of a reaccumulation was replaced five weeks ago. The discharge is slight, but requires two dressings daily. Temperature and pulse have been normal for two weeks. Present condition: A well developed young man with a fistulous operation in left seventh intercostal space to the outer side of the scapular angle. The drainage-tube, six inches long, leads into a cavtiy which holds a little over three ounces.

Physical examination shows normal resonance and vesicular breathing as low as the fourth rib in the line of the fistula. Below

this level, dullness and very faint respiratory sounds Patient being on his way north for the summer, was advised to return for operation in the fall.

Operation Jewish Hospital, November 7, 1901. Condition of patient unchanged. Long incision in line of fistula with the cut surrounding, but not passing through it. Subperiosteal resection of five inches of the sixth and seventh ribs. Through the incision of the soft parts a cavity lined by a dense membrane was opened. Its floor was readily inspected and found just within reach of the finger-tip. An incision was made through the membrane down to the lung with a view to decortication. Owing to the depth of the surface and the density of the membrane this was impracticable. Noticing that the incision widened under observation a second one was made, then a third and a fourth. These were crossed by other incisions and one was gradually made along the groove of reflection of the thickened pleura from the lung to the parietal wall. The lung expanded visibly from the moment the first cut was made through the thickened pleura. As much as possible of the thickened costal pleura was excised. Light packing with iodoform gauze. The patient's temperature rose rather sharply for four days after the operation and resumed the normal by the end of the tenth day. He left the hospital December 4 with the wound nearly closed. By the first of January the wound had closed entirely without leaving any deformity, and the breathing-sounds at the site of operation were normal. There has been no recurrence.

Case II.—Frank T., aged 20, dental student; admitted to Cincinnati Hospital, April 22, 1900, for a stab wound of the abdomen. In the eighth intercostal space in the line of the anterior axillary fold there is a punctured wound apparently made with the blade of a pocket-knife. The patient is very much shocked and vomits blood. Immediate laparotomy by an incision along the left costal border reveals much blood in the abdomen coming from a clean wound in the anterior wall of the stomach. The wound, which was about an inch in length, was closed by a double row of sutures. The posterior wall of the stomach was not injured. Immediately after the operation the patient was removed to a private room in the hospital. Two weeks after the injury, when the patient seemed about recovered, there

developed a left-sided pleurisy with great dyspnœa, displacement of the heart to the right side of the sternum, and grave general symptoms of sepsis. On the fifth day after the inception of this complication, drainage was established by the resection of an inch or more of the sixth rib. Fully a quart of pus with many shreds of lymph and clotted blood was discharged. The lung was found greatly retracted, and expanded but little from the relief of tension. Cultures showed the infection to be of the streptococcus type.

While the operation was followed by some improvement in breathing and the return of the heart to its normal place, the pneumothorax did not seem to decrease. The fever continued high during fully two weeks, when a counter opening was made with a resection of an inch or more of the seventh rib behind the posterior axillary line. This more efficient drainage caused some improvement, but it failed after four weeks' faithful trial, with frequent irrigations, to either do away with the high temperature or reduce the size of the cavity. The only breath-sounds faintly audible on the left side were heard behind on a level with the scapular spine. Therefore, multiple rib resection with removal of the thickened costal pleura was determined.

Operation, June 20, 1900. Resection through three long incisions of the fifth, sixth, seventh, eighth, and ninth ribs. The pieces of the ribs resected decreased in length from below upwards. From the inner surfaces of the musculocutaneous bridges left by the incisions the thickened pleura was scraped away. The pulmonary pleura was freely incised by gridironing incisions, and a marked expansion of the lung was immediately noticeable. The upper portion of the empyemic cavity could not be reached, but because of the weakened condition of the patient further operation was refrained from. The patient bore the operation well and improved rapidly. Three weeks later a fifth operation was performed on him. Portions of the second, third and fourth ribs were resected, and the costal pulmonary pleura treated as before. After six months' stay in the hospital he returned September 22 to his home in Hillsdale, Mich., where under the care of Dr. Sawyer complete recovery ensued. I saw the patient two years after the operation. He was in perfect health. There was relatively little sinking in of the chest-wall,

although the defect in the bony thorax is nearly ten inches in height and one and one-half to five inches in width. There is no apparent regeneration of the ribs.

CASE III.—Mrs. G. B. S., widow, aged 30. Entered Good Samaritan Hospital May 22, 1903. Family history negative. Husband died of tuberculosis in Colorado three years ago. About one year after his death the patient was seized with severe pains in the right side of the chest and right shoulder, and began to cough. This condition continued for two months, with evening exacerbations of temperature. Ten weeks after the beginning of her illness thirty-five ounces of pus were removed by aspiration. Three days later the temperature rose to 104 in the evening, and continued so for four weeks, when an incision for drainage was made. The wound has discharged for over twenty months.

Present condition: The patient is confined to her bed most of the time and is very anæmic. Pulse always rapid and small. Evening temperature ranging between 100 and 101. There is some cough but no expectoration. The right side of the chest is very much retracted and immobile. The lower intercostal spaces are very narrowed. In the sixth space in the axillary line there is a small fistula with rigid and indurated margins. The probe passes upwards and inwards for a distance of eight inches. There is a cavity here which holds about thirty ounces; any attempt to force more into it causes violent coughing. Vesicular breathing suspended over the front and side of the chest below the fourth rib. It is very faintly heard above. Sputum examination negative. Diagnosis: Chronic empyema.

Operation May 25, 1903. Subperiosteal resection through three incisions of the fifth, sixth, seventh, and eighth ribs. The overlapping of the ribs made the resection somewhat difficult, although this part of the operation was very much facilitated by Doyen's ring-shaped costal periostotome. The diaphragm covered by a dense membrane projected far into the chest cavity, and the greatly retracted lung was freely exposed in the depth of the large wound. The thickened parietal pleura was easily dissected away. The adventitious membrane over the diaphragm was easily incised and the incision widened somewhat. Free discission of the pulmonary pleura, as in the previous cases. The wound was loosely packed with tampons of iodoform gauze, the ends

of which were made to project through the incisions in the soft parts. The patient promptly recovered from the operation, and was enabled to return to her home, with a fistula leading into the upper portion of the empyema cavity.

Second operation, October 13, 1903. The patient now presents the appearance of perfect health. There is a fistula some five inches in depth in the line of the upper incision, made at the previous operation. Resection of the second, third and fourth ribs, with treatment of the pleura, as in the previous operations. The patient left the hospital after three weeks with the wounds practically closed. She presented herself for examination eighteen months after the second operation. She is in perfect health. There is very little deformity of the chest-wall nor is there any deflection of the spinal column. The respiratory expansions are almost as great as on the sound side.

CASE IV.—Nicholas M., aged 34. Admitted to Cincinnati Hospital October 15, 1904. Family history negative. Was brought into the hospital with a penetrating wound of the chest. One inch to the right of the twelfth dorsal spine there is an incised wound about one inch in length, apparently non-penetrating. Two inches to the right and between the tenth and eleventh ribs there is a second incised wound about an inch in length, which is penetrating. Urine analysis negative. Wounds are dressed aseptically after the custom of the hospital October 16, temperature somewhat elevated. Pulse 100 and a fair tension; respiration increased to 36 per minute. There is pain on the right side of the chest on breathing.

Physical examination shows dry pleuritic rub in the axilla and around posterior wound. Was ordered $^1/_{40}$ grain of strychnia every three hours, and purgation by calomel and enema. Ice-bags were ordered to abdomen and chest. October 17 flatness over whole right side of the chest, with absence of breath-sounds posteriorly and in axilla. Breath-sounds exaggerated anteriorly. Pain over the right side of chest on breathing. Respiration shallow and labored. Temperature 101. When the dressing was changed a quantity of dark and infected blood escaped from the upper wound with each respiration and especially on coughing. There escaped altogether thirty-four ounces from the pleural cavity.

Under ether anæsthesia drainage was established. The patient's condition, while it improved somewhat, was not materially changed as to the intrathoracic condition. There had been developed an empyema with retraction of the lung. Temperature ranged in the course of two weeks between 99 and 104.

Operation December 4, 1904, under ether anæsthesia. Schede resection of right chest-wall with resection of five ribs and the removal of the thickened parietal pleura. Discission of the pulmonary pleura with distinct widening of the incisions visible during expirations. Wound packed with gauze. From this day on the highest temperature fell to 102. In order to complete the obliteration of the empyemic cavity a second resection was made on December 29, when three ribs were resected. With the expansion of the lung now following the discission, the cavity was completely obliterated. From this time on the patient recovered his strength. His weight rose from 97 pounds to 110 pounds. He was discharged on April 27, since which time the wound has closed permanently. He is again at his usual work of driving a beer-wagon, doing all the hard labor that may be required in the discharge of his work.

It would have been easy to increase the number of cases of empyema that have come under my observation, but I have refrained from referring to those which come in very young subjects and those of later life which are secondary to tuberculosis with or without pulmonary fistula. The prognosis in the first class is usually so good when early drainage is instituted, and in the second class often bad notwithstanding any method of treatment, that I believed it wise to mention only cases of traumatic origin and those clearly the sequel of a metapneumonic process. In looking over cases of this character in adults, it became evident at once that aspiration and even incision without rib resection is of little service. In all of these cases multiple resection should be made at an early period and before the strength of the individual has been reduced by prolonged sepsis. In the operation for chronic empyema with fistula, certain rules can be formulated, which, if followed with-

out making every operation absolutely schematic, will be reasonably certain after one or two procedures to cause complete obliteration of the cavity with very liberal expansion of the retracted lung.

First. Every operation on the thorax for pleuritic effusions of any kind should be done with the patient upon his back or slightly resting on the sound side.

Second. An incision should be made above the fistulous opening and a piece of one of two ribs removed in order that the cavity may be subjected to inspection and to touch.

Third. According to the size of the cavity thus determined, multiple subperiosteal rib resections are to be made either through a number of parallel incisions, through the U-shaped Schede incision, or through a trap-door incision, a method favored by the French surgeons. It matters little which of these methods be practiced, provided that the resections be ample and that the thickened parietal pleura be excised.

Fourth. Attention should then be given to the diaphragm and the pulmonary pleura. Incisions here should be made after the manner described. If the thickened pleura can be removed by decortication easily, it is perhaps preferable. If ample expansion of the lung does not ensue, an incision in the groove of reflexion of the costal and pulmonary pleura must be made.

Fifth. The condition of the patient should be carefully watched, lest too much be done at one sitting. When the cavities are large, repeated operations are necessary for the safety of the patient. In one case, which I saw with Prof. Evans, no less than eight operations were necessary to effect a complete cure.

THE MOVEMENTS OF THE STOMACH AND INTESTINES IN SOME SURGICAL CONDITIONS.*

BY WALTER B. CANNON AND FRED T. MURPHY,

OF BOSTON, MASS.

(From the Laboratory of Physiology and the Division of Surgery in the Harvard Medical School.)

CONTENTS.

Movements of the Stomach immediately after Intestinal Operation.. 513
The Effects of End-to-End and Lateral Intestinal Junction..... 517
The Effects of Intestinal Obstruction 521
The Effects of Thrombosis and Embolism..... 524
The Question of Post-operative Paralysis of the Intestine..... 526
1. *The Effect of Etherization*..... 527
2. *The Effect of Exposure to Air* 528
3. *The Effect of Cooling*..... 530
4. *The Effect of Handling*..... 531
Summary..... 534

THERE has been within recent years much physiological investigation of the motor activities of the alimentary canal. The results of this investigation are in some instances of value for their bearings on surgical problems, but usually the relation between the physiological and the surgical conditions is too indefinite to permit exact conclusions to be drawn. On the other hand, a review of the literature of surgical experimentation on the alimentary canal shows that the interest has been largely restricted to such questions as the healing of intestinal sutures and the bounds of possible removal of portions of the large and small intestine without causing death. Relatively little attention has been paid to the behavior of the gastro-intestinal tract after abdominal operations or in conditions demanding surgical interference.

* The results of this investigation were presented before the Boston Society of Medical Sciences, November 21, 1905.

The research here presented is an attempt actually to see how the stomach and intestines move, and how the food is treated by the motor activities of these organs, under various surgical conditions in comparison with normal states. Only certain surgical situations were selected for study. These were: The immediate consequences of operation; the results from different varieties of intestinal suture; the effects of stenosis and obstruction, and of embolus and thrombosis, and the question of postoperative paralysis. The movements of the food in the digestive tract in each of these conditions will be considered in turn in the following pages.

The method employed in this investigation was that used by Cannon and Blake,[1] in an experimental study of gastro-enterostomy and pyloroplasty.

In brief the principles of surgical cleanliness and technique were observed in the operations, and in the preparation and after-care of the animals. To watch the movements of the stomach and intestines, subnitrate of bismuth in small amount was added to the food, and the changes of the shadows of the food, cast upon a fluorescent screen by the Röntgen rays, indicated the activities of the walls of the alimentary canal. Thus the animal was observed, without etherization or drugging, in a quite natural state except for the operation. Any marked deviation from the normal functioning could therefore be regarded as due to operative interference. Because cats are easily observed with the Röntgen rays, and because standards of activity under normal conditions have been established for these animals,[2] they were used in the present investigation. For twenty-four hours previous to operation or observation the animals were given no food.

MOVEMENTS OF THE STOMACH IMMEDIATELY AFTER INTESTINAL OPERATION.

In order to test the immediate effect of intestinal operation on a definite activity of the alimentary canal, the rate of discharge of food from the stomach was chosen. When cats

are given by stomach tube 25 c.c. mashed potato mixed with 5 gms. bismuth subnitrate, gastric peristalsis begins soon after the food is introduced; and usually within ten minutes the pylorus has relaxed and permitted some of the gastric contents to enter the intestine. As pointed out in a previous investigation [3] the *aggregate length* of the shadows of the intestinal contents at different times after feeding, may be taken, in the early stages of intestinal digestion, as evidence of the rate of discharge from the stomach. Potato, for example, ordinarily leaves the stomach rapidly; at the end of a half hour the average aggregate length of the shadows of food-masses in the small intestine is about 10 cm.; at the end of an hour, about 30 cm., and at the end of two hours the amount of food in the small intestine attains its maximum, with the length of the shadows aggregating 43 cm. The question to be settled was the effect of intestinal operation on this rate of discharge from the stomach.

The intestinal operation performed to aid in answering this question was either simple section of the gut or resection of about eight inches, followed by end-to-end union by means of the F. G. Connell suture. The operation in the first cases was done about 18 cm. below the pylorus. The etherization lasted uniformly one half-hour, so that the anæsthesia-factor was fairly constant. Usually within twenty minutes after the etherization is stopped the animals so far recover as to be able to sit up and move about. A half-hour after the stopping of the anæsthesia the animals were given by stomach-tube 25 c.c. mashed potato with 5 gms. bismuth subnitrate. The times of observation—one half-hour, one hour, and every hour thereafter for the first seven hours after the feeding—corresponded to the times of observation adhered to in establishing the standard of activity in normal conditions. A permanent record of the distribution of the food in the alimentary canal was kept by tracing on transparent paper laid over the fluorescent screen, the outlines of the shadows cast by the food. The aggre-

gate length of the shadows of the intestinal contents at the regular times of observation, under normal conditions, and in a typical case after intestinal section about 18 cm. from the pylorus, is presented in the following figures:

Time in hours	½	1	2	3	4	5	6	7
Normal	9.0	31.0	43.0	25.0	21.0	13.5	9.0	4.0
After section	0.0	0.0	0.0	0.0	0.0	0.0	7.0	8.0

In Figure 1 is shown graphically a comparison of the amount of food in the small intestine at regular intervals after feeding potato, both under normal conditions and immediately following intestinal section and suture. Under normal conditions this food begins to leave the stomach soon after its ingestion, usually within ten minutes, and the dis-

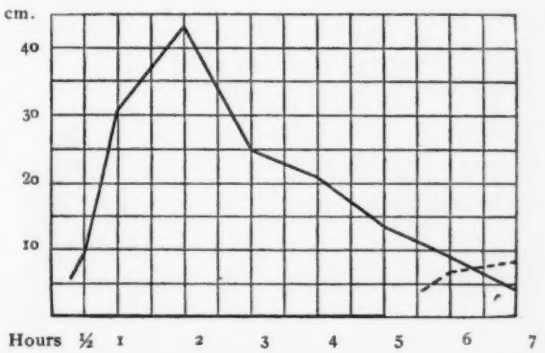

FIG. 1.—Curves showing the aggregate length in centimetres of the masses of potato present in the small intestine at regular intervals for seven hours after feeding. The continuous line represents the normal condition; the dash-line the typical condition immediately following intestinal operation near the pylorus. The delay is due to continuous closure of the pylorus, for gastric peristalsis was seen at every observation after the first half hour.

charge continues so rapid and abundant that the stomach is emptied in about three hours. After high intestinal operation, on the other hand, this food began to emerge from the stomach only after five or six hours. The delay, as will be shown later, was not due to etherization or to section of the abdominal wall.

This striking difference between the normal and post-operative discharge of carbohydrate food from the stomach is

due to an altered functioning of the pyloric sphincter. The gastric peristaltic waves under normal conditions are seen running continuously, so long as food remains in the stomach.[4] In these postoperative cases, likewise, at every observation after the first half-hour of digestion, peristaltic waves were seen coursing regularly over the stomach to the pylorus. And under normal conditions, as already stated, the pylorus relaxes usually within ten minutes after the ingestion of such food as potato, whereupon the peristaltic waves begin the discharge into the intestine. But in these postoperative cases, in spite of peristaltic rings pushing the food up to the pylorus about five times a minute for more than five hours, the sphincter held perfectly tight against this repeated recurrence of pressure and did not permit the food to pass on into the injured gut.

The remarkable character of this protective mechanism of the pylorus appears in comparing the time required for primary cementing of intestinal wounds with the time during which the food is retained in the gastric reservoir. "Under favorable circumstances a firm lymph or gluey exudate, which is a natural means of repair, is promptly thrown out and spread around and upon any wound of the peritoneum, either visceral or parietal. It often begins to appear firm and available to hold surfaces together within two hours. The usual time, however, when it may be expected to afford efficient support is after at least six hours have elapsed."[5] It is certainly very striking that the period of primary repair and the period during which the food is prevented from entering the injured intestine should so closely coincide.

From evidence which is to be presented later, as to the paralyzing effect of handling, it seems probable that the immediate region of intestinal suture is protected from any demand for normal functioning by the manipulation incident to the operation. Some evidence on this point was secured by making an intestinal section and suture (end-to-end) about 3 cm. above the ileocæcal valve. The animal was fed as pre-

viously described. Food was first seen to have left the stomach at the end of two hours; and during the remainder of the seven hours of observation it continued to accumulate in the small intestine. In normal conditions mashed potato reaches the colon in two or three hours after it is fed; but in this case at the end of seven hours nothing had yet appeared in the large intestine. There was no evidence of obstruction, such as bulging of the gut and powerful and repeated peristalsis in the region of stasis. The intestinal masses merely accumulated and remained unmoved. It may be that at any point along the alimentary canal injury produces a functional blocking effect which saves the injured part from activity until a certain degree of repair has taken place.

In all cases observed there was no question of the patency of the lumen of the gut. The day after the operation and the feeding the total remnant of the food was invariably found in the large intestine, and the animal was in the best of spirits.

The mechanism causing the pylorus to remain closed for so many hours while gastric peristalsis continues active is left undetermined. Whether the injured intestine is the origin of a reflex effect on the pylorus, which is mediated through the central nervous system or through the local nervous mechanisms of the intestinal wall, is a matter for further investigation.

THE EFFECTS OF END-TO-END AND LATERAL INTESTINAL JUNCTION.

In resecting the intestine to remove stricture, in getting rid of gangrene, lacerations and large perforations, intestinal union must be employed. Clinical experience has not yet determined whether end-to-end or lateral methods of uniting the divided intestine are preferable. In favor of the lateral junction the argument has been urged [6] that it permits conveniently a desirable large contact of serous surfaces—a condition said not to be possible in the end-to-end union without dangerously narrowing the lumen of the canal and without liability

of producing ischæmic necrosis from pressure on mesenteric vessels involved in the suture. It has also been claimed for the lateral anastomosis that it can be used without regard to the size of the intestinal parts to be united, and that with it the opening between the two intestinal ends can be made as extensive as may be wished. On the other hand the tendency of all lateral unions of the parts of the alimentary canal to undergo cicatricial stenosis has been repeatedly recognized. And studies on animals have shown that indigestible substances, such as straw and hair, may accumulate at the point of lateral union and block the passage.[7] It is stated, however, that such a condition has never been cited as true of man whose diet must be and is carefully watched after operation.

From theoretical considerations there are possibilities of functional disturbance both in the end-to-end and in the lateral union. There exists in the intestinal wall a reflex mechanism such that a stimulus at any point causes contraction above and relaxation below that point.[8] It is thus that masses of food are pushed through the alimentary canal. In the end-to-end junction two severed ends of the intestine are sewed together. It is conceivable that the transverse cutting of the gut destroys locally the nervous mechanism governing peristalsis, and that under these conditions there is a stasis of the food in the region of the union. In lateral anastomosis the circular muscle-fibres of the canal are cut—the fibres which force the food onward. Contraction of the circular muscle singly in either one or the other of the overlapping intestinal ends could not force the food onward, but must simply shift the food over into the inactive part. In order that there shall be propulsion of the contents of this region there must be a coördinated, advancing contraction of the circular fibres simultaneously in the two apposed loops. As already noted undigested material has been found as a remnant in the region of lateral junction. Is there in this region a stasis of the normal food material?

In order to try these possibilities of functional disturbance, intestinal sections and resections were made in animals and the severed gut then united either end-to-end or laterally. The operation was performed as near as possible beyond the delicate fold of mesentery which holds the end of the duodenum in place. There are two advantages in having the operation at this point: The point is fixed so that the position of the suture can be recognized fairly accurately in observations with the X-rays; and also, the point is so near the stomach that the observer does not have to wait long after feeding the animal before the food reaches the region he wishes to study.

Observations were made on different animals one, four, seven, and ten days after end-to-end union of the intestine. In no case was the slightest evidence of stasis of the food in the region of operation to be observed. The food was passed along that part of the intestine as it was passed along other parts.

The results were quite different with lateral anastomosis. Animals permitted to live ten days or two weeks showed usually the condition already mentioned as observed by Senn and Reichel—a more or less complete blocking of the canal by accumulated hair and undigested detritus at the opening between the apposed loops. In order to see whether there was a stoppage of the normal food at the anastomosis, animals were operated upon and carefully fed for four days on food with little waste. Then they were given a rather thin boiled starch (4 gms. starch : 100 water) with an admixture of subnitrate of bismuth. As long as this food was passing through the intestine some of it was always present at the junction. And when almost all the unabsorbed material was in the colon there still remained a large mass filling the widened lumen where the coils were laterally joined. Observation the next day showed the mass still at the anastomosis. Autopsies on these animals proved that the stasis of the food was not due to previous accumulation of indigestible waste. The region

of junction was filled, not with hard material but with a pasty stuff, in physical characteristics much like that seen ordinarily in the small intestine, and certainly capable of easy transmission through the gut by peristalsis. It is evident that in these cases the two apposed coils did not act together to propel the enclosed food. The food was forced through the region of the union by a push from behind, a push exerted by the peristalsis of the intact wall driving new particles of food from time to time into the accumulation at the junction. And when no food remained to act as an intermedium between the accumulated mass in the widened lumen and the pressing peristalsis of the intact gut there was nothing to continue the propulsion of the food through the chamber formed by the united loops, and the mass was left unmoved.

Inasmuch as stasis of the food was not observed at any time after end-to-end union of the severed gut, while after lateral anastomosis the ordinary food was stagnant in the region of junction, it is clear that, other things being equal, the end-to-end union is to be preferred to the lateral for rapid resumption of the normal functioning of the canal. It is known that in some cases at least after lateral union the canal may become changed from a crooked to an almost straight tube.[9] Possibly as such an alteration takes place there may be a restitution of the functional efficiency of the joined parts. It must be admitted, however, that the absence of this functional efficiency, for some days certainly and probably for weeks after the operation, renders lateral anastomosis not an ideal procedure. And on the other hand, the dangers of the end-to-end union have been largely obviated by recent improvements in the technique of intestinal surgery. The use of the F. G. Connell suture has permitted us to join the ends of the cat's severed intestine, an intestine with a thick wall and a relatively small lumen, a large number of times with never a sign of obstructive narrowing of the lumen, and with so little of the intestinal wall turned in as to make compression of mesenteric vessels and ischæmic necrosis highly improbable

contingencies, yet such firmness of union that there was never doubt that the junction would be strong and tight. As to the claim made for lateral anastomosis that it permits the opening between the two intestinal ends to be as large as one may wish, it may be stated that this can be done only by more extensive cutting of the circular muscle of the intestine, thereby still further interfering with peristaltic activity; and also, that the condition to be desired is not so much a large opening as an opening that functions satisfactorily.

Although our experiments have led us to differ from the opinions of Ashton and Baldy [10] as to the universal desirability of lateral approximation, we agree with them as to the danger of allowing the blind ends of the intestinal loops in lateral union to extend beyond the anastomotic opening. If they each extend beyond the opening, the proximal closed loop, in our experience, is in danger of becoming packed with hardened waste; and the end of the distal loop is likely to invaginate until the invaginated portion fills the lumen in the region of the anastomosis and produces obstruction.

THE EFFECTS OF INTESTINAL OBSTRUCTION.

The manner in which food was treated when the lateral anastomotic opening became completely closed by accumulated detritus, led to further observation on intestinal obstruction. For this purpose stenosis was produced by tying a coarse linen ligature tightly around the gut near the duodenal band. When animals were treated in this manner we found it necessary to make observations upon them within a day or two after the operation; if the interval was longer, the ligature sank so deeply into the intestinal wall as to be entirely covered by peritoneum. Under these circumstances the narrowing effect of the ligature naturally became less and less with the lapse of time.[11] Animals in which a part of the intestine had been reversed, and cases of operative kink, served also for observation on the effects of intestinal obstruction.

The presence of obstruction in the intestine even within

25 cm. of the pylorus did not retard the discharge of food from the stomach. As the food collected in the obstructed gut there was seen in every instance a remarkable exhibition of intestinal activity. Ordinarily in the small intestine a repeated segmentation of the food into small masses is a much more common activity than peristalsis. Peristalsis is only an occasional occurrence.[12] But in these cases of obstruction the food was over and over again pushed toward the obstruction by repeated waves of peristalsis. And the moving constrictions were evidently powerful, for as they advanced, the walls of the canal in front were bulged widely by the compressed contents; and when the peristaltic ring could no longer withstand the pressure it was causing as it moved, the

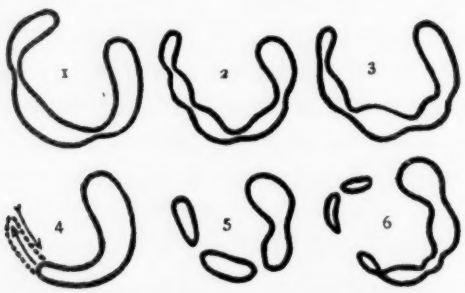

FIG. 2.—Tracings of the shadows of the contents of an obstructed loop of intestine, showing the sequence of changes through segmentation and peristalsis during a few moments of observation about an hour and a half after feeding. In the condition represented by No. 4, there was repeated peristalsis with regurgitation of the food through each advancing peristaltic ring.

contents squirted back through the moving ring for some distance along the gut. No sooner had one wave passed over the accumulated food to the point of blocking than another would start and go over the same course again, or a series of rhythmic contractions would occur, dividing the contents into large segments and sometimes separating them widely from one another. The numbered parts in Fig. 2 are tracings of the sequence of changes in the shadows of the food during a few moments of observation about an hour and a half after feeding boiled gluten-flour. Similar activities, though not so

violent, were seen taking place an hour previous. Other cases, observed during a longer period, showed this same vigorous squeezing and churning of the accumulated food, alternating, however, with periods of rest.

It is clear from the observations above recorded that in the presence of intestinal obstruction there is aroused an activity of the circular musculature which must tend to compensate for the obstruction, and work to obviate it. These results support a contention made in an earlier investigation [13] that under normal conditions kinks and sharp bends in the intestine must have food forced through them by peristalsis. A kink was artificially produced by turning a loop back on itself for about 4 cm. and sewing together the surfaces in contact. Observation five days later proved that the food was pushed around the very sharp bend of the tube by the vigor of the peristaltic waves.

In order to test whether functional intestinal obstruction could be caused by opposing the directions of peristalsis, various lengths of the small intestine were in several animals resected and sutured end-to-end but with the direction reversed. Our results in the main confirm those of Mall and others [14] who have experimented on intestinal reversal. Although food was driven through when the reversed portion was relatively short—about 20 cm. in length,—there was in all cases an enlargement of the tube and a stasis of undigested waste in the region of the upper suture. These observations are generally interpreted as proof that antiperistalsis of the small intestine, a reversal of the direction of its motor function, does not occur. Opposed to this conclusion is the clinical evidence that in cases of intestinal obstruction there may be continued vomiting of offensive decomposed material after the stomach has been repeatedly washed—the so-called " fecal vomiting."

In relation to this conflict of evidence, observation made on an animal with a reversal of about 20 cm. of the intestine just beyond the duodenal band is of interest. The observation was

made six days after the operation. At the autopsy soon after the observation a heap of indigestible stuff was found obstructing the canal at the upper suture. With the X-rays the food had been seen again and again to leave the stomach; as it collected in the duodenum it moved onward, with occasional segmentation, through a definite course which was traced on transparent paper; finally it began to accumulate in the region of the upper suture. About a half hour after the feeding the whole mass began to be tossed about by the alternating periods of segmentation and peristalsis already described as characteristic of the state of obstruction. Suddenly the mass was seen to be divided near the enlargement of the upper suture; then the proximal part of the mass was moved rapidly back along the course which had been traced, even up to the pylorus. This reversed movement of the food has been seen repeatedly with perfect distinctness. The method used does not permit seeing the contractions of the intestinal wall; only the effects of such movements on the food can be observed. But if food had been moved forward as in this instance it was certainly moved backward, the movement must assuredly have been attributed to peristalsis. It seems to us probable that a direct study of peristalsis in animals in which obstruction and stasis of food have been caused may prove that in such conditions reversal of the normal direction of peristalsis readily occurs.

THE EFFECTS OF THROMBOSIS AND EMBOLISM.

In testing the effects of thrombosis and embolism, either the veins or the arteries supplying more or less extensive areas (varying from 10 cm. to most of the small intestine) were tied, and the connecting arches in the mesenteries were also tied to prevent collateral circulation. Care was always taken to avoid including nerves in the ligatures. In both conditions there was a sudden stoppage of a continuous supply of nutriment and oxygen to the parts involved. It was perhaps to be expected, therefore, that there would be, as in human beings, a similarity of effects in the two conditions.[15]

The operation was performed in every case during a uniform period of etherization—one half-hour; and about an hour and a half after the operation the animals were fed 25 c.c. mashed potato mixed with 5 gms. bismuth subnitrate. Three animals were taken for each condition. In only one of the six there was any activity of the stomach and intestines. In that one (a case of embolism) food passed out from the stomach for a time; then the pylorus closed and, although gastric peristalsis continued for about four hours, there was no further accumulation of food in the intestine. At the autopsy the gut just above the affected part was found somewhat dilated with food, but the gut below was wholly clean and free from contents. In the other five animals there was no gastric peristalsis and no discharge of food into the intestine.

The absence of gastric peristalsis in these cases of embolism and thrombosis of the intestine notably distinguishes them from the cases of high intestinal operation. Usually within an hour the animal vomited, and if the gastric contents were not at that time mostly ejected the animal ordinarily vomited again. And within three or four hours the animals usually began to exhibit a condition of lethargy and tonelessness, which increased as time passed. The extent of the intestine involved in the disturbance of circulation seemed to make little difference in the effects.

Autopsy of the animals with veins tied revealed the typical anatomical changes described by investigators who have studied experimentally hæmorrhagic infarcts of the intestine.[16] In the involved portion of the gut, the wall was thick and tense with infiltration, the lumen contained a thick bloody mass resembling clot, and a free sanguinous fluid was present in the peritoneal cavity. The involved portion of the intestine in the cases of artificial embolism was not so greatly altered as in the thrombosis cases, but it was red and injected, was moderately distended, and contained a foul grumous stuff slightly reddened.

The inactivity of the bowel, after food had entered it, in

the case of artificial embolus above reported, illustrates one of the three types of dynamic ileus in Nothnagel's classification [17] —the type attended by anatomic lesions, such as embolism and acute general peritonitis. Of the other two types—toxic entero-paralysis, and functional nervous paralysis of the gut—the latter is of special surgical interest, since probably to that type belongs the intestinal paresis occasionally following laparotomy.

THE QUESTION OF POST OPERATIVE PARALYSIS OF THE INTESTINE.

According to Kocher [18] the non-inflammatory dynamic ileus after abdominal operations depends upon a slight adhesion of the intestinal coils due to injury to the serosa, either circumscribed or extensive, and he thinks it probable that the circulatory disturbances following laparotomy exert an important influence on the contractility of the intestine. Scant credit is given to the idea that dynamic ileus is a purely functional disturbance—" little mechanical obstacles lie at the bottom of it." Nothnagel [19] on the other hand, reported a case of pure *ileus paralyticus,* with tympanites and other symptoms of obstruction, but showing at autopsy no cause of intestinal inactivity. Similar cases are seen after contusion of the testicle, after abdominal injury with a blunt instrument, after the relief of strangulated hernia, and during severe attacks of renal or biliary colic.

It is evident that postoperative paralysis of the alimentary canal must arise from the general condition of the patient, from alterations produced by the operation, or from a combination of the two. If the general condition of the patient is good, the trouble following operation may be due to the nature of the surgical interference or to the factors attending the surgical procedure. The character of the disorder to be attacked may leave little choice as to the nature of the surgical operation, but the manner of operating is to an important degree under control. And if the duration of the etherization, or the ex-

posure of the stomach and intestines to the air, or the cooling or the handling of them, tends to produce functional disorder, it should be known. With the object of learning the action of these factors attending abdominal operation, they have been studied in their effects on the discharge of food from the stomach and its passage through the small intestine.

1. *The Effect of Etherization.*—In order to test the effect of etherization animals were etherized one half hour or one hour and a half; and about a half-hour after the etherization had been stopped 25 c.c. mashed potato mixed with 5 gms. bismuth subnitrate were given. As in the standard normal

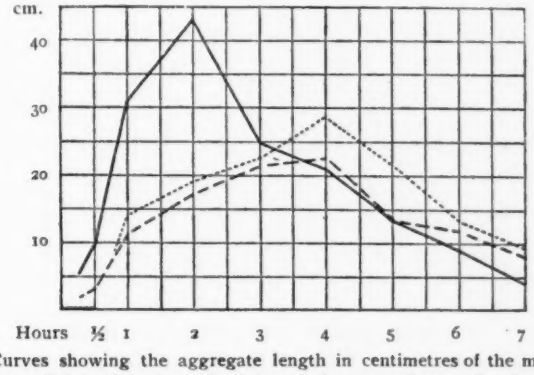

FIG. 3.—Curves showing the aggregate length in centimetres of the masses of potato present in the small intestine at regular intervals for seven hours after feeding. The continuous line represents the normal condition, the dash-line the typical condition after etherization for a half hour, and the dotted line the typical condition after etherization for an hour and a half.

cases, tracings of the shadows of the food in the stomach and intestine were made at the end of the first half hour after the feeding and then every hour for seven hours. The following figures show in centimetres the aggregate length of the food masses in the small intestine at the regular times of observation, in the normal condition and after etherization:

Time in hours	½	1	2	3	4	5	6	7
Normal	9.5	31.0	43.0	25.0	21.0	13.5	9.0	4.0
Etherized ½ hr.	3.0	11.0	17.0	21.5	22.5	13.5	12.0	8.0
Etherized 1-½ hrs.	0.0	14.0	19.0	22.5	28.5	21.5	13.0	9.0

In Fig. 3 is shown graphically the differences between the

aggregate length of the food masses in the intestine under normal conditions and after etherization. It is clear that the anæsthesia alone,—in distinction, for example, from high intestinal operation or thrombosis and embolism accompanied by anæsthesia during the operation,—has a relatively slight effect on the rate of discharge from the stomach. When an animal has been etherized an hour and a half, the chances are that the initial passage of food from the stomach will be for a short time delayed. But whether the anæsthetic has been administered a half-hour or triple that time, the most marked alteration in the passage of the food from the stomach is the slowing of the rate of discharge. The curve rises slowly instead of abruptly. And corresponding to the slow rate of gastric discharge, is a slow passage through the small intestine; the food appeared first in the large intestine, not at the end of two or three hours, as was the case when potato was fed to normal animals, but at the end of four, five and six hours after the feeding—a slightly greater retardation in the cases of etherization for an hour and a half than in the cases of etherization for thirty minutes.

The etherization therefore does not cause an inactivity of the alimentary canal; it seems merely to produce a slowing of the movement of the food through the canal.

2. *The Effect of Exposure to the Air.*—In testing the effect of exposure to the air, the anæsthetic was given for a few minutes over a half hour. As soon as complete anæsthesia was reached a long median abdominal section was made, the abdominal flaps were held widely apart, and the omentum drawn close to the stomach, so as to expose the small intestine and stomach as much as possible. Care was taken not to touch the viscera during these manipulations. Thus the visible surface of the stomach and intestine was exposed to the air, and was kept exposed for thirty minutes. During this time the serosa became dry and lost its glisten. Then the abdomen was closed. After recovery from ether the animals received the usual amount of potato with subnitrate of bismuth. The

following figures represent the aggregate length of the food masses in the small intestine at the regular times of observation, in the normal condition, and after etherization with exposure of the alimentary canal to the air for half an hour:

Time in hours	½	1	2	3	4	5	6	7
Normal	9.5	31.0	43.0	25.0	21.0	13.5	9.0	4.0
After exposure	8.0	13.5	22.0	29.5	33.5	23.5	17.0	12.0

In Fig. 4 these figures are represented to show graphically the differences between the normal condition and the condition following exposure. It will be seen that the discharge from the stomach is not delayed,—the food begins to pass into the intestine within the first half-hour. The outgo is slow,

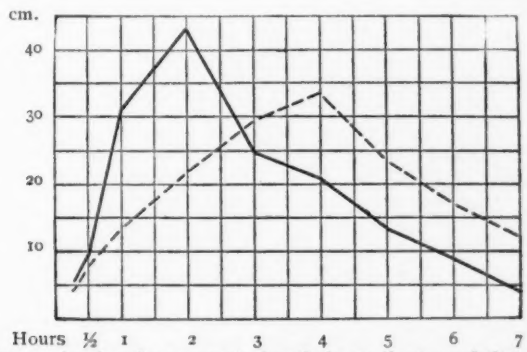

FIG. 4.—Curves showing the aggregate length in centimetres of the masses of potato present in the small intestine at regular intervals for seven hours after feeding. The continuous line represents the normal condition; the dash-line the typical condition following etherization with exposure of the stomach and intestines to the air for a half-hour.

but, curiously enough, not so slow as in the cases of etherization alone. Nothing was seen in the large intestine until the end of six hours—an interval not exceeding that observed when the animals were merely etherized.

As long ago as 1872 Von Braam Houckgeest noted the disturbing effects of drying on the action of the intestines,[20] and, in order to study the natural activity made use of a bath of warm normal salt solution. It might be supposed that if gastro-intestinal movements are inhibited during exposure to the air, they might be considerably altered after exposure. Such seems, however, not to be the case. The activities are not

checked; the slowing of the passage of the food through the canal is explained as the normal effects of the anæsthetic.

3. *The Effect of Cooling.*—Not only does drying the surface of the alimentary canal cause a cessation of its movements; cooling the body has the same effect.[21] Does a temporary cooling of the stomach and intestines, without drying, stop the movements of these organs? In order to answer this question, ether was administered as usual for a half hour, and within that time, for ten minutes, sterile normal salt solution with a temperature of 20° C. was poured at intervals into the opened abdominal cavity. The body temperature, by rectum, was thus reduced to nearly 33° C. About forty minutes after the ab-

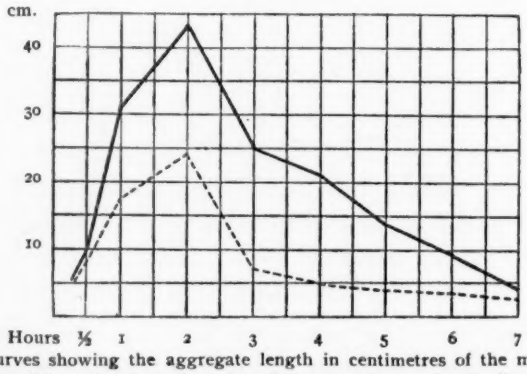

FIG. 5.—Curves showing the aggregate length in centimetres of the masses of potato present in the small intestine at regular intervals for seven hours after feeding. The continuous line represents the normal condition; the dash-line the typical condition after etherization, and cooling of the abdominal cavity with sterile normal salt solution at 20° C. The early drop in the dash-line is due to the rapid passage of the food into the large intestine.

domen had been closed and the etherization discontinued, the animal was given the usual food. In the following figures may be seen the differences between the aggregate length of the food-masses in the small intestine at the regular times of observation, in normal conditions and in a typical case after cooling the alimentary canal:

Time in hours	½	1	2	3	4	5	6	7
Normal	9.5	31	43	25	21	13.5	9.0	4.0
After cooling	8.0	17	24	7	5	4.0	3.5	2.5

Fig. 5 is a graphic representation of the content of the

small intestine in the normal condition and after cooling. The discharge again is somewhat slow, but the passage through the small intestine is surprisingly rapid. The first appearance of food in the large intestine in this case was at the end of three hours, and at the end of four hours almost all of the remnant of the food was in the colon. The rapid drop in the curve between the second and third hours is thus explained. It must be admitted that the degree of cooling—to a body temperature of about 33° C.—was excessive. Nevertheless, the departure of food from the stomach was not slower than when the abdominal contents were merely exposed to drying; and certainly the rapid passage of the food through the small intestine lends no support to the supposition that cooling in itself causes enteric paresis.

4. *The Effect of Handling.*—In studying the effect of handling on the functioning of the stomach and intestines, it is desirable to consider different degrees of manipulation. Unfortunately an exact standard of severity of handling is difficult to establish. The experimenter can know that he has taken hold of the gut more or less harshly, and he has to be content with such general characterizations in reporting his results.

In all cases the animals were etherized one half hour, within which the abdomen was opened and the stomach and intestines manipulated. In the most severe treatment of these organs they were stripped between the thumb and first finger with considerable pressure, as would be done in forcing out the contents; in the less severe treatment these organs were fingered gently in air, or in a trickling stream of warm normal salt solution, with the parts protected from the fingers by absorbent cotton wet with the solution; or run through the bare fingers, but wholly within the peritoneal cavity. About an hour after stopping the anæsthetic the animals were fed as in former experiments and the observations were taken at the usual intervals. In the following figures is shown at regular periods of observation the content of the small intestine, in

total lengths of the food-masses in centimetres, under normal conditions and after various manipulations:

Time in hours	½	1	2	3	4	5	6	7
Normal	9.5	31.0	43.0	25.0	21.0	13.5	9.0	4.0
Under warm salt solution...	0.0	0.0	0.0	11.0	21.0	29.5	24.5	13.5
Gently, in peritoneal cavity..	0.0	0.0	0.0	8.5	9.5	15.5	26.0	23.5
Gently, in air	0.0	0.0	0.0	4.5	8.5	11.0	12.5	13.4
Severely, in air	0.0	0.0	0.0	0.0	3.5	5.5	6.5	9.5

The relation of these typical cases to the normal condition is shown graphically in Fig. 6. In examining the figures and the curves, it should be kept in mind that since neither the etherization alone, nor such cooling and drying

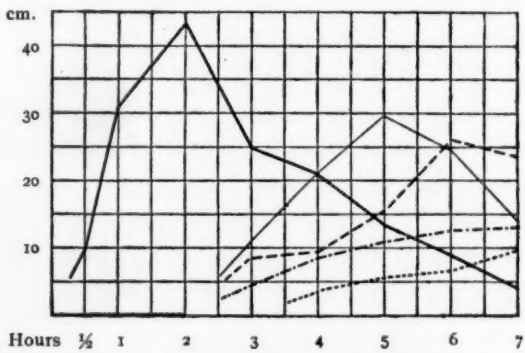

FIG. 6.—Curves showing the aggregate length in centimetres of the masses of potato present in the small intestine for seven hours after feeding. The heavy continuous line represents the normal condition; the light continuous line the typical condition after handling the stomach and intestine gently under warm normal salt solution; the dash-line the typical condition after handling the organs gently in the peritoneal cavity; the dash-and-dot line after handling them gently in the air; and the dotted line after handling them severely in the air.

as the viscera in some cases suffered, cause a delay in the escape of food from the stomach, the delay must have been due to the manipulation. Even when the stomach and intestines were handled most gently, either under warm normal salt solution or within the peritoneal cavity, no movements of the stomach were seen, and no discharge into the intestine, for three full hours after the feeding. Even after the first departure of food from the stomach the discharge continued very slowly as shown by the sloping of the curve; and the passage

through the small intestine was also retarded. In only one case did food appear in the large intestine before the end of the seven hours of observation.

When the organs were removed from the abdomen and handled gently in air the movement of the food was retarded to a greater degree than when they were fingered in the peritoneal cavity or under warm normal salt solution. So great was the retardation that in the case recorded on the above table not all the food had passed into the large intestine from the ileum even twenty-six hours after the feeding. Indeed, the condition then was that reached under normal conditions in about five hours.

With rougher treatment in air food was first passed from the stomach only after four hours. Thenceforward it departed very slowly and, as shown by the permanence of position from observation to observation, was carried through the small intestine with extreme sluggishness. In one case of severe manipulation no food had left the stomach at the end of seven hours. And in another case the food had not yet reached the large intestine twenty-four hours after the feeding (the food used begins to appear there normally at the end of two or three hours); only a slight amount of food was in the small intestine, and the stomach was still well filled.

Manipulation of the stomach and intestine, even gently and under most favorable circumstances, produced in our experiments much greater effect in the direction of postoperative inactivity than any other of the factors concerned in the manner of operating. Whether the manipulation produces its effects directly on the mechanisms in the wall of the alimentary canal, or indirectly through reflex inhibitions from the central nervous system, remains to be determined. Goltz's success in stopping the frog's heart by tapping on the intestines [22] suggests that the intestine may be sensitive to mechanical treatment to a degree not commonly realized; and this sensitiveness might very readily result in the same sort of reflex inhibition that occurs when a testicle is crushed.

It should be kept clearly in mind that the animals used in these observations were vigorous normal specimens. Furthermore it may well be that the intestine of these animals is normally less sensitive to stimulation than the human intestine. It seems probable therefore that what is true of these experimental animals is also true of man, but to a greater degree. And when the strength has been sapped and the bodily vigor lost, the factors which operate to check the activities of the alimentary canal must have a greatly increased effect. During the course of other researches on the movements of the food in the stomach and intestines one of us (C.) has had repeated opportunity to observe animals in conditions of asthenia, animals suffering from distemper, with purulent inflammation of nose and eyes, with soft toneless muscles, and every appearance of debility. Nothing is more remarkable than the responsiveness of the alimentary canal to such a condition. All day long food will lie in the stomach without the slightest sign of a peristaltic wave passing over it. There is a total stoppage of the motor activity of the digestive organs. In asthenic states leading to such conditions the handling of the alimentary canal, which we find produces the most marked paralyzing action, can only cause an intensification of the effect of the general bodily weakness, a deepening of the state of inactivity.

SUMMARY

In studying the movements of the stomach and intestines in some surgical conditions, animals were etherized usually one half-hour, operated upon, and subsequently fed food mixed with a small amount of subnitrate of bismuth. Fluoroscopic observations of the changes in the contents of the alimentary canal were then made by means of the Röntgen rays.

After high intestinal section and suture, gastric peristalsis is not interfered with. But for almost six hours after recovery from the ether the pylorus remains tightly closed against the peristaltic pressure and does not permit the food to pass into the injured gut. There is a striking coincidence between the

duration of the delay of the discharge from the stomach and the period of primary cementing of intestinal wounds.

After end-to-end suture of the severed intestine no inefficiency of the gut in the region of suture was observed. But after lateral anastomosis there was always an accumulation of food in the chamber formed by the apposed loops. The cutting of the circular fibres in this operation destroys efficient peristalsis at the junction unless the circular muscles of both loops work in coördination. As they do not so act, at least for days and probably for weeks, following operation, lateral anastomosis is not so ideal an operation as the end-to-end union.

In case of intestinal obstruction, food leaves the stomach without delay. As it accumulates above the obstruction violent peristalsis repeatedly occurs, tending to force the food past the obstacle. The peristalsis alternates with vigorous segmenting movements. After such turbulent treatment the food has been observed moving swiftly *backward* to the stomach along the course traversed in its passage from the stomach to the region of obstruction.

After thrombosis and embolism there is usually no movement of stomach or intestine; the food lies quiet in the stomach until discharged by emesis. In one case gastric peristalsis was observed for some hours and a slight amount of food was discharged into the intestine, but it gathered above the infarcted region and was not advanced further.

In studying the conditions attending operation as possible causes of postoperative paralysis of the alimentary canal, etherization, one half or one and a-half hours, was found not to delay to any marked degree the discharge of food from the stomach; exposure to the air and unusual cooling of the gut likewise caused no noteworthy delay; but by far the most striking effects were seen after handling the digestive organs. Even with most gentle handling, within the peritoneal cavity or under warm salt solution, no gastric peristalsis was seen and no food left the stomach for three hours. Fingering gently in the air caused still greater retardation of the movement of the food.

And with rough handling in air no food passed from the stomach for four hours, and then it emerged very slowly and was moved onward with every evidence of extreme sluggishness of the intestine.

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[3] Cannon. Loc. cit., p. 389.

[4] Cannon. American Journal of Physiology, 1898, i, p. 367.

[5] Abbe. Wood's Handbook of the Medical Sciences, New York, 1902, v, P. 176. Dr. Abbe has written to us that the statement quoted above was based on observations made by him on the healing of intestinal sutures in dogs, sheep and other animals.

[6] Küttner. Beiträge zur klinischen Chirurgie, Tübingen, 1896, xvii, p. 505.

[7] Senn. ANNALS OF SURGERY, 1888, vii, p. 265, and Reichel; Münchener medicinische Wochenschrift, 1890, xxxvii, p. 197.

[8] Bayliss and Starling. Journal of Physiology, 1902, xxiv, p. 110.

[9] Edmunds and Ballance. Medico-chirurgical Transactions, London, 1896, p. 263.

[10] Ashton and Baldy. Medical News, 1891, lviii, p. 235.

[11] Although it has been known since the time of Sir Astley Cooper (Lectures on the principles and practice of surgery, London, 1824-27) that a thread tied about a lifted piece of the intestinal wall would sink into the tissue and later reach the lumen, the fact that in gastroenterostomy wires are sometimes applied about the gut to close the lumen and require the food to take a desired course, indicates that the lesson of Cooper's observation has not been well learned.

[12] Cannon. American Journal of Physiology, 1902, vi, p. 256.

[13] Cannon and Blake. ANNALS OF SURGERY, 1905, xli, p. 703.

[14] See Mall. Johns Hopkins Hospital Reports, 1892, i, p. 93; and Prutz and Ellinger. Archiv für klinischen Chirurgie, 1902, lxvii, p.

[15] Welch. Allbut's System of Medicine, New York, 1899, vi, p. 218.

[16] See Tangel and Harley. Centralblatt für die medicinischen Wissenschaften, 1895, p. 673.

[17] Nothnagel. Diseases of the Intestines and Peritoneum, English Translation, Philadelphia, 1904, p. 585.

[18] Kocher. Mittheilungen aus dem Grenzgebieten der Medizin und Chirurgie, 1899, iv, p. 201.

[19] Nothnagel: loc. cit., p. 585.

[20] Von Braam Houckgeest. Archiv für die gesammte Physiologie, 1872, vi, p. 266.

[21] Lüderitz. Virchow's Archiv, 1889, cxvi, p. 49.

[22] Goltz. Virchow's Archiv, 1863, xxvi, p. 10.

THE TECHNIQUE OF GASTROJEJUNOSTOMY.

BY WILLIAM J. MAYO, M.D.,

OF ROCHESTER, MINNESOTA,

Surgeon to St. Mary's Hospital.

THE mortality of gastrojejunostomy is no longer the question. The results are as good as can reasonably be expected, and depend more upon the condition of the patient when operated upon than the technical difficulties of the operation itself.

This is particularly true of the posterior-suture operation, of which variety we have made 136 in 16 months with but one death. These results are not exceptional and have been and are being duplicated by many others. Neither need we consider those serious cases of regurgitant vomiting of biliary and pancreatic secretions during the first week (vicious circle), as this complication has practically disappeared with the evolvement of better methods.

While we therefore can congratulate ourselves upon the immediate safety of the operation itself, we are not yet free from certain embarrassing complications which may arise some days or weeks later. The most common subsequent condition is the chronic regurgitation of bile which comes on at intervals in a small percentage of patients. The symptoms vary from a temporary burning in the stomach, due to the entrance through the fistula of biliary and pancreatic secretion, to the most distressing vomiting of great quantities of such fluids. Ochsner has pointed out that if this complication develops it is usually within ten weeks of the operation. On reoperation the condition is found to be due to a partial kinking or obstruction from twisting, adhesions or other cause, just as the acute "vicious circle" was due to early and more complete obstructions.

Since January 1, 1905, Dr. Charles H. Mayo and myself

have discarded all " loop operations " with or without entero-anastomosis or closure of the pylorus, the anastomosis being made as close to the origin of the jejunum as possible. The results as compared with all previous methods in our hands have been infinitely better in every respect. The few " loop " operations that have been performed during this time have been to meet special indications.

From January 1 to July 1, 1905, there were 56 of these " no loop " operations with but one death, which occurred in a patient practically moribund at the time of operation. Two patients, however, developed chronic bile regurgitation of a serious character. These two cases are the ones referred to in a paper on " Chronic Ulcer of the Stomach and First Portion of the Duodenum," read before the American Medical Association, July, 1905, and published in the *Journal of the American Medical Association,* October 19, 1905. Each had gained in flesh and weight, being relieved of former symptoms, but in each occasional regurgitation of quantities of biliary and pancreatic secretions was a source of great discomfort and considerable disability. Reoperation in both cases during the past summer showed that the cause of the trouble was an angulation of the jejunum at its gastric attachment.

In all of the 56 cases referred to the anastomosis of the jejunum to the stomach was made in the line of peristalsis, that is, the proximal portion of the jejunum was attached to the posterior gastric wall to the left and above, and the distal end of the jejunum to the right and lower part of the stomach. In this partial twisting lay the secret of the complication. (Fig. 1.)

The question at once arises. Is the idea of continuity of peristalsis between the stomach and jejunum a matter of theory or has it some practical significance? The writer has gone over in a large number of living subjects the anatomy of this region, and the anatomical facts can be briefly stated as follows:

For convenience we will take the origin of the jejunum as being at the point in which the duodenum passes through

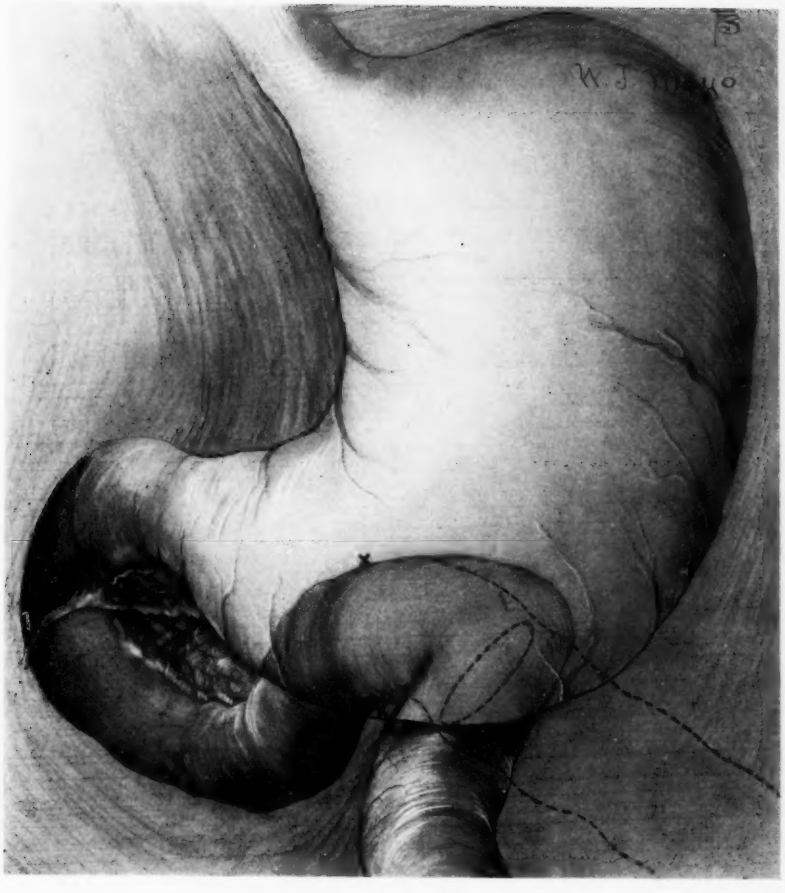

FIG. 1.—Showing kink in jejunum resulting from changing normal direction of its uppermost portion, in "no-loop" gastro-jejunostomy after posterior method.

X and x mark commencement of jejunum.

the transverse mesocolon. The distal end of the duodenum lies behind the stomach when the latter is moderately distended and about one and one-half inches to the left of the middle line and one and one-half to two inches above the umbilicus. Its horse-shoe shape has its concavity directed to the left and upward and its exit is within about two inches as high as the pylorus. The transverse portion of the duodenum passes forward over the prominent vertebral column and backward to the left side of the spine to the opening in the transverse mesocolon. The terminal inch which marks the duodenojejunal juncture is directed upward and to the left, the mesentery of the proximal jejunum lying behind and the free surface of the intestine directed forward. The jejunum from its origin drops at once into the left abdominal fossa. Not only does it pass to the left but it gravitates backward into the left kidney pouch underneath the splenic flexure of the colon, so that at a point four inches from its origin it lies on a plane to the left and posterior. This can be shown in a very practical way by drawing the transverse colon out through the abdominal incision, pulling it upward and to the right until the mesocolon is taut. This brings the beginning of the jejunum into view. It will readily be seen therefore that if the attachment is made to the stomach so that the proximal portion of the gastrojejunostomy is to the left and above, and the distal portion is directed to the right and below, we have introduced two serious displacements. The jejunum no longer falls in the normal manner to the left and backward, but is artificially caused to pass not only to the right but forward as it must ride the vertebral column or the structures immediately contiguous.*

The active propulsion of the stomach lies in the pyloric end in that part bounded above by the horizontal portion of the lesser curvature. The five-sixths lying to the left has mainly storage function and its muscular action is less forceful. The proper site for the gastric incision is to the left of this point

* For variations in the origin of the duodeno-jejunal angle see Mumford, Fustut and Cunningham.

on a line with the longitudinal part of the lesser curvature with its lower end at the bottom of the stomach (under the cardiac orifice).

The writer has been unable to see that it made any difference in the results of a "no loop" gastrojejunostomy whether the peristalsis of the stomach is the same as that of the intestine or not, as, with the exception of a tendency to contraction, there have been no complications introduced that have been other than intestinal in origin.

Since the first of July, 1905, we have abandoned reversing the jejunum and in a larger number of cases (65) we have had not a single case of trouble and no death. We apply the jejunum to the posterior wall of the stomach from right to left exactly as the intestine lies under normal conditions. The distal portion of the jejunum passes from the bottom of the stomach directly back into the left fossa as occurs normally (Fig. 2).

The two accompanying drawings by Miss Byrnes from sketches by Dr. John F. Binnie from actual operations at our hands explain the mechanical conditions very perfectly. It is hardly necessary to say that the idea of the reversal of the peristalsis is not original with us, but will be found in the literature on this subject to have been advocated at various times. As a matter of fact, in this operation it is of no importance.

With any "loop" operation (four inches or more in length) the objections which we here make to the mechanics are not so apparent, but mechanical difficulties of some kind are so frequently introduced as to render gastrojejunostomy with entero-anastomosis the method of choice with the larger number of operators.

The "no loop" operation directed to the left, as outlined above, has given us vastly better results than any other method with which we have become acquainted.

Steps of the Operation.—For benign disease the abdomen is opened from three-fourths to one inch to the right of the

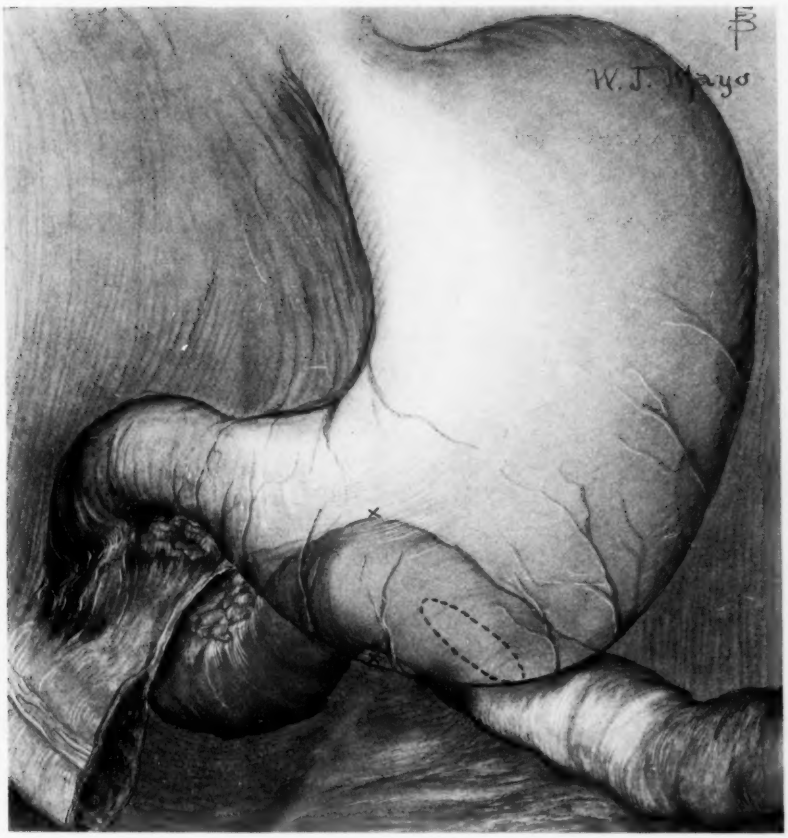

FIG. 2.—Showing NO kink in jejunum resulting from PRESERVING normal direction of its uppermost portion, in "no-loop" gastro-jejunostomy after posterior method.
X and x mark commencement of jejunum.

median line, splitting the fibres of the rectus muscle. The transverse colon is drawn out of the abdominal incision and by a steady traction to the right and upward the mesocolon is brought out until the jejunum comes into view, and the intestine is grasped at a point three or four inches from its origin. On drawing the jejunum tight the fold of peritoneum which covers the ligament of Treitz (a small band containing muscle fibres) is developed. This peritoneal band has its origin on the transverse mesocolon and extends down on to the beginning of the jejunum, acting as a suspensory ligament; it will be found to lead to the base of the vascular arch of the middle colic artery, and accurately marks the place where the transverse mesocolon is torn through to secure the posterior wall of the stomach. The stomach is drawn through this opening and the anastomosis performed, beginning at a point one inch above the greater curvature on a line with the longitudinal portion of the lesser curvature and ending at the bottom of the stomach, two and one-half inches to the left. To secure a proper low point a small opening is made in the gastrocolic omentum and one-half inch of the anterior wall pulled through behind. Having these features in view a considerable portion of the posterior wall is drawn into a pair of light elastic curved holding clamps. We prefer the Doyen. The handles lie to the right and about transverse with the axis of the body. Beginning one and one-half to three and one-half inches from its origin the jejunum is drawn into a similar pair of clamps with handles to the right. It will thus be seen that the left low point on the stomach lies in the tip of the clamps and the distal point of the jejunum lies also to the left. By placing the two clamps side by side the operation is completed in the usual manner by two-row suturing, chromic catgut-suture being used for the inner through-and-through mucous stitch, as silk or linen may hang ulcerating for months before passing away. In applying this suture on the posterior row behind we use the Connell or buttonhole suture. On the anterior we use the method advised by Dr. Charles H. Mayo, which con-

sists in entering the needle on the peritoneal side through to the mucous and directly backward from mucous to peritoneum on the same side. By doing this alternately, first on one side and then on the other, with this first chromic catgut-suture the peritoneal surfaces are rolled into contact, the parts to be united are held firmly in apposition, and the hemorrhage checked. The outer row consists of No. 1 celluloid linen (Pagenstecher), which we have used with great satisfaction since it was introduced for this purpose by Mr. Robson. It is very strong, smooth and has no capillarity. Flattening the intestine (Cannon and Blake) should be avoided by grasping the intestinal wall close to the margin of the incision with the suture so as to turn in a narrow seam from the intestinal side. On the gastric side on the contrary, there need be no hesitation in taking a free grasp of the tissues. The rent in the mesocolon is fastened to the suture line with three or four mattress-sutures of linen. This should grasp the peritoneal coat close to the margins of the rent in such manner that when tied all the raw surfaces shall be turned in behind the stomach, and the peritoneum folded smoothly against the gastrojejunostomy opening so that there shall be nothing to cause adhesions to form between the mesocolon and the jejunum beyond the anastomosis.

This short communication is to supplement the paper on "Gastro-enterostomy" read before the American Surgical Association, July, 1905, and published in the ANNALS OF SURGERY, Nov. 1905, in which article credit has been given to originators and promoters of useful suggestions in perfecting this operation.

THE RELATIVE VALUE OF CECOSTOMY AND APPENDOSTOMY IN THE TREATMENT OF AMEBIC DYSENTERY BY IRRIGATION OF THE COLON.

BY HOLTON C. CURL, M.D.,

SURGEON, UNITED STATES NAVY,

Superintendent, Colon Hospital, Isthmus of Panama.

AMEBIC dysentery is of sufficient interest to military surgeons and to those working in the tropics to warrant a thorough study of it from all standpoints. The etiology and symptomatology have been quite thoroughly studied, and preventive medicine has, in many places, been of the greatest benefit in lessening the number of cases in a given locality. The results of the treatment, however, are as yet unsatisfactory. Remedies given by mouth are not efficient and, in many cases, irrigation per rectum is unable to control the disease. The use of irrigating solutions introduced in the region of the cecum was begun some two or three years ago and its exact place in surgery is still undetermined. Our experience with the operation at the Colon Hospital has been interesting as well as instructive. We have reached the conclusion that the operation is not justified in late cases where there is great prostration and great changes in the mucous membrane and submucous tissues of the large intestine. On the other hand, early cases can be controlled by irrigation per rectum, combined with proper diet and rest.

There remains an intermediate class in which ordinary treatment is unavailing, where there is an increasing number of stools daily, where considerable strength remains but patient is weakening. These cases grow worse and usually die. It is in this class only that I consider the operation indicated.

As to the technique, two methods are in use: (1) By the formation of a fistula directly into the cecum and the irrigation

of the colon through a catheter inserted into the gut; and (2) by the use of the appendix, the catheter being introduced *through it, neither operation is in itself dangerous in the least;* with ordinary aseptic care, there is little reaction and adhesions are readily formed. Occasionally the appendix, from its position, cannot be brought up without making too much tension on the cecum. There is little difference in the difficulties ordinarily presenting themselves, and but a few minutes are required for the completion of the operation. On several occasions I have gone down to the peritoneum under cocaine, and completed the operation by the use of a very little chloroform.

Of the two methods, I prefer the cecostomy as done by the simple gridiron method and the gut fastened by a continuous catgut-suture to the parietal peritoneum. The four "corners" of the wound (that is, where the angles are formed by the two edges of the external oblique crossing the internal oblique) are anchored by sutures passed through both muscles and the peritoneum. These are usually of silk, left long, and are very convenient in exactly locating the point at which to open the gut. This can usually be done after twenty-four hours, but if there is no special urgency, forty-eight hours' time is allowed. The opening should be only large enough to admit a catheter of small size, through which the quinine solution can be introduced. The catheter can be left in position with a clamp to prevent leakage, or it can be replaced by a conical pad and reintroduced when desired. The closure of this class of openings is sometimes difficult, but usually they heal kindly after the planes of muscle are dissected out, the gut inverted and closure carefully done.

In the use of the appendix, various methods were tried by us: (1) It was brought out through the internal oblique, given an " " shaped turn, and brought out through the external oblique and skin through an opening below; (2) it was brought directly through the entire wall and sutured to the skin; (3) it was brought well into the wound and the base of the appendix sutured to the parietal peritoneum. The

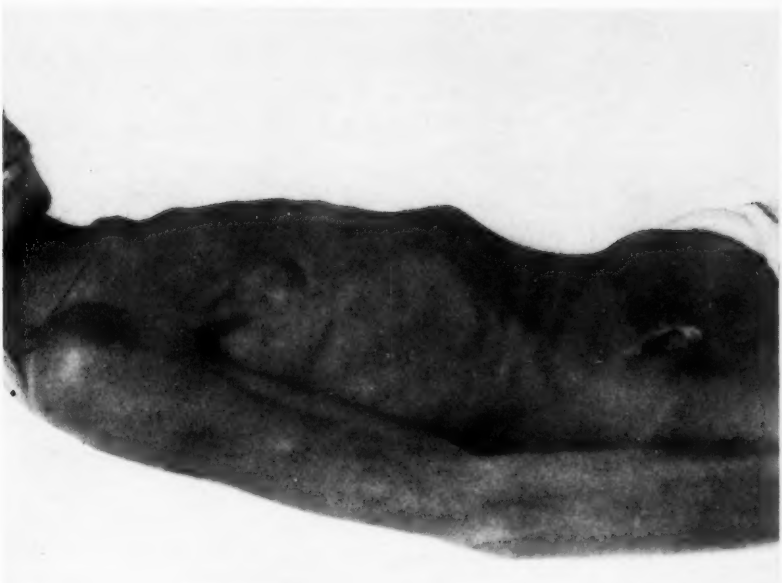

FIG. 1.—Photograph of a typical case of cecostomy for dysentery taken on the 12th day; the usual slight sloughing is well indicated. This man entirely recovered.

results were not as satisfactory as in the cases in which the cecum proper was used; the circulation in the appendix, even when most carefully handled, was uncertain and, in three cases, the organ sloughed. There is a certain amount of secretion from the mucous membrane of the appendix, which tends to prevent any spontaneous closure of the sinus, and it was more difficult to close these wounds, when the need for the irrigation no longer existed, than in the other class of cases. On the other hand, there is a decided advantage in being able to immediately irrigate the colon, if the case is an urgent one, even while the patient is on the table.

In the cases in which the appendix was not used for irrigation, it was removed merely as a precautionary measure. The ordinary normal appendix,—and such are almost invariably found among the negro and native population of the Isthmus,—will admit a small catheter very readily, much more so than one would think unless his attention had been especially called to it.

In eight cases out of eleven there was partial or complete recovery. In two cases the conditions, as demonstrated at autopsy, were those of very extensive ulceration, and both had nephritis. One case was so weak that the operation was done almost entirely under cocaine, there was very little depression afterward, but death occurred before the opening of the gut could be done on the next day.

In the cases that recovered, the record of stools on the day before operation showed from 12 to 30, and in the two who died soon after operation, the movements were uncontrolled and practically continuous. In seven cases the stools dropped to one or two on the fourth day, and in three cases, there was but one stool on the third day. These three had had, respectively, 12, 15 and 22 stools, with blood and mucus, on the day prior to operation. While immediate improvement took place, convalescence was slow and more than one operation was needed in closing the fistulæ in four of the patients. Relapses,

after negative stools for some weeks, occurred in three cases; further irrigation again cleared up the condition.

In one case in which there was clinically a complete cure, an opportunity for autopsy was secured by the patient's death from beri-beri three months later. The gut was found in excellent condition, the sinus closed and a broad, firm attachment of the cecum to the abdominal wall.

SUMMARY.

In " intermediate " cases, in which there is still a reasonable amount of strength but where treatment is not controlling the dysentery, the operation of cecostomy with irrigation of the colon with quinine solution is indicated. Cecostomy is preferred to appendostomy because of less sloughing and an easier closure of the fistula. The appendix should be removed at the time of fastening the cecum in the abdominal wound.

A rapid improvement usually follows the beginning of irrigation, but convalescence is slow, and at times difficulty is experienced in closing the fistulæ. The after treatment,—irrigation, etc.,—is tedious, and the patients are offensive cases to have in a ward. All in all, it is the lesser of two evils, but in my opinion, it saves lives in selected cases.

THE USE OF SILVER WIRE FOR THE CURE OF LARGE HERNIÆ.[1]

BY JOSEPH WIENER, JR., M.D.,

OF NEW YORK,

Adjunct Attending Surgeon, Mount Sinai Hospital.

THE object of writing this paper is to draw attention to a somewhat neglected field of reparative surgery. I confess that when I first began to use silver wire for the cure of herniæ I was skeptical as to its value. The more I have used it, the more convinced I have become of its great value. True, there are certain technical points which must be borne in mind to get the best results. Increasing experience in this respect has taught us valuable lessons.

The subject was first brought to our attention by Witzel and Goepel, almost simultaneously, in 1900. Though almost six years have elapsed, with the exception of articles by Willy Meyer, Bartlett, and Perry, but little has been written on the subject. Witzel used a number of sutures of silver wire with which he partly closed the hernial opening, and he then passed thin silver wires in every direction across the opening still remaining. This was a tedious and time-consuming method. Goepel was the first to employ the ready-made filigree of silver wire. He reported eleven cases of ventral and umbilical and seven cases of inguinal hernia, in which he had used the filigree. There were only two failures, due to the formation of hæmatoma, which necessitated the removal of the filigree. If all bleeding be carefully arrested no hæmatoma will develop. Furthermore, we now know that even if there is some infection of the wound, with a resulting sinus, the filigree need not be removed. The wound will ultimately heal and the filigree remain in place. The largest filigree used by Goepel was four

[1] Read before the Surgical Section of the New York Academy of Medicine on February 2, 1906.

and a-quarter by six and three-quarter inches. This gives an idea of what the filigree can do in the cure of herniæ.

My interest in the subject was first aroused by an excellent and convincing paper by Bartlett, which appeared in the ANNALS OF SURGERY in 1903. The filigree I have employed has been that devised by Bartlett, and I have followed his directions closely. He advised the use of the ready-made filigree, made of thin wire, not heavier than gauge No. 30. The heavier wire is not resilient enough, and does not adapt itself so well to the tissues, and in consequence it is apt to cause irritation. Another advantage of the filigree over silver-wire sutures is the fact that it can be introduced very quickly. Furthermore, and this is a matter of great importance, the filigree can be placed between the tissues at a much greater distrance from the edges of the opening than would be possible in passing a needle. It should widely overlap the hernial opening on all sides. No sutures are required to hold the filigree in place. If anyone doubts the correctness of this statement, he has but to remember what happens when we inadvertently leave a piece of gauze in a wound. How quickly are the meshes of the gauze filled with granulation tissue, which anchors it in place so firmly that it can only be removed with the greatest difficulty. The same process goes on with the filigree. In a few weeks it is so firmly anchored in place that great force is required for its removal. This has been proven experimentally on animals. Another advantage in not suturing the filigree in place is the fact that it can then better adapt itself to the surrounding tissues, and there is less likelihood of its causing any irritation. If properly made and properly inserted it should cause no discomfort whatever; the patient should not be aware of its presence.

The form of filigree used by the writer has been that devised by Bartlett, and described in his article in Volume 38, ANNALS OF SURGERY, 1903. As is well known, scars in the abdominal wall generally spread most in a lateral direction. The filigree, which can be readily made by anyone,

depends for its efficacy upon the fact that all but one of the wires run across the long axis of the hernial opening. The filigree should overlap the opening by at least an inch all around. It is so made that each cross-wire ends in a loop, thus obviating sharp ends. If sutures of silver wire are used, they should not attempt to approximate the tissues (a frequent cause of failure). The sutures should be made into a sort of filigree, they should fill in the gap of the hernial opening, and there must be no tension whatever. It is always better to depend on two layers of silver; either two filigrees in two different planes, or one filigree and one reinforcing layer of silver sutures, provided the superficial muscles or fascia can be approximated without any tension. In general it is well to place the filigree as deeply as possible; sometimes it is not necessary to open the peritoneal cavity. But the filigree must extend well beyond the hernial opening on all sides. This necessitates dissecting up the muscles all around before introducing the filigree. Then the superficial plane of muscles or fascia may be united with silver-wire sutures, or a second filigree is introduced. Or, a filigree can be made by a running suture of wire that does not approximate the tissues, but simply fills in the gap. By following this method we have a double guard against recurrence of the hernia.

To show that by this method a hernia can be cured even in the presence of intra-abdominal tension which has been increased by pathological processes, reference may be made to two cases of Bartlett's. One was a case of hernia following Talma's operation for cirrhosis, and the other was a case of tubercular peritonitis. In the former case, in spite of the fact that there had several times been a decided reaccumulation of fluid, the filigree prevented the recurrence of the hernia. Of the ten cases in which Bartlett used it, he has never had to remove it, and he has observed some of his cases over two years.

The writer has used either the ready-made filigree or one made with running silver-wire sutures. Five of the cases were in the service of Dr. Howard Lilienthal, to whom I am

indebted for permission to publish the cases. In a private case the wire was used for a ventral hernia following a median cœliotomy. Fifteen months have elapsed and the patient has not only been cured of a troublesome hernia, but also has been free from any discomfort due to the presence of the wire. In two cases there were large inguinal herniæ with wide separation of the tissues. One case was an umbilical hernia, one a ventral hernia following an injury, and one a ventral hernia following an operation for appendicitis. In no case has it been necessary to remove any of the wire.

Case I.—Israel M., 53 years old, was first admitted to Mount Sinai Hospital in November, 1902. There had been a gradually-increasing right inguinal hernia for three years. The hernia had been irreducible for one year, and there had been several attacks of abdominal pain. On admission, the hernia was 58 cm. in circumference, and being only partly reducible it interfered with walking. On opening the sac, Dr. Lilienthal found it to contain small intestines, cæcum and ascending colon, the latter firmly adherent to the sac. The adherent appendix was removed. The sac was so firmly adherent to the cord and testis that their detachment was impracticable. Accordingly, the testis, cord, and part of the sac, were removed; the intestines were replaced and the neck of the sac closed with chromic gut. The reduction of the intestines proved a difficult and tedious task, as more than half of the small intestines were in the sac. No sutures were used; the wound was packed with gauze and a compression bandage was applied. During the convalescence there was some sloughing of the fascia and of the deeper tissues. A large exudate which formed in the scrotum necessitated incision. Two and a half months after operation the man left the hospital with a healed wound. He was instructed to wear a truss and to return for observation.

Six and a half months later the man returned to the hospital. He stated that the hernia which could no longer be retained by a truss, was becoming progressively more troublesome. It was only partly reducible, and prevented the man from earning his living. Even when the dangers of the operation were explained

to him, he begged for relief. On August 19, 1903, I excised the scar tissue and opened the sac. It was found impossible to reduce the many coils of small intestine until the patient was placed in Trendelenburg's position. Even then it was only with great difficulty that the intestines were replaced. The sac was then freed from adhesions, tied off and allowed to slip back into the abdomen. The inguinal canal was so large that any approximating sutures were not to be thought of. The inguinal ring was narrowed by a purse-string suture of silver wire. A silver-wire filigree was now sutured over the inguinal canal, and the superficial fascia and skin brought together with interrupted sutures. A small gauze drain was left at the lower angle of the wound. Following the operation, the attempt was made to keep the foot of the bed elevated. On attempting to elevate it much the man complained of nausea and retching, and he became short of breath and cyanosed. Although the bowels moved daily, the patient was never comfortable. He became more and more restless and three days after operation he began to vomit. This continued, cyanosis and increased restlessness developed, and the man died six days after operation. Examination of the wound showed that the filigree was in place and that there had been no infection. Death was undoubtedly due to the fact that the abdominal cavity could not accommodate itself to the large amount of intestines which had been in the sac. Some of these large inguinal herniæ can surely be cured by the use of silver-wire filigree when all other methods are of no avail.

Case II.—Mrs. Ray M., 34 years old, was referred to me by Dr. Louis Cohn. In October, 1900, she had been operated on by Dr. Bull, who removed diseased adnexa through a median incision. Drainage had been employed at the lower angle of the wound. Five months after the operation a hernia first showed itself at the lower portion of the scar. In July, 1901, the patient had a sudden attack of pain in the right side of the abdomen, accompanied by vomiting and fever. The attack lasted a week, and had been followed by a number of similar ones. The hernia gradually increased in size; it became painful and could no longer be retained by a truss.

Hernioplasty, October 27, 1904. The sac was opened by a transverse incision four and a half inches long and a median

incision two inches long. It contained a large mass of omentum. The neck of the sack was slightly to the left of the median line, but the hernial protrusion had lifted up the skin in front of the left rectus, and extended nearly in the flank. The omentum was replaced, the appendix removed, the sac completely dissected out, and tied off at its neck. The peritoneum was closed with a running catgut suture. The posterior sheaths of the recti and the muscles themselves were approximated with chromic gut sutures. The fascia could only be partly approximated without tension. The gap was filled in with silver wire sutures passed from side to side so as to produce a filigree. The skin was sewed with silk, and a cigarette drain placed at either angle. The wound healed by primary union. Sixteen months have elapsed since the operation; there has been no recurrence, and there has been no discomfort from the silver wire.

Case III.—William K., 30 years old, admitted January 6, 1905. The man had had an oblique right inguinal hernia for three years, and a similar hernia on the left side for one year. Operation on the right side by Dr. Lilienthal. For the Bassini sutures, instead of chromic gut, twisted silver-wire sutures were used. The operation on the left side was performed by the writer. There was such a wide separation of the deeper structures that it was impossible to approximate them. Accordingly, the gap was bridged over by a continuous suture of silver wire, returning the suture so as to make a sort of figure-of-eight filigree. The superficial fascia was united with catgut and the skin with silk. Both wounds healed by primary union. It will very seldom be necessary to resort to the silver wire in cases of inguinal hernia, but when we have such a case, the silver wire, if used as a filigree and not as approximating sutures, will be found satisfactory. The silver wire used in this case was in the form of a cable of very thin wires, and was devised by Dr. Lilienthal. It is much more pliable than a single strand of heavier wire, and can readily be tied into a knot.

Case IV.—Louis R., 37 years old, admitted May 5, 1905. Two months before admission the man, while getting off a moving car, was thrown against a steel column. He sustained a fracture of the humerus, dislocation of the clavicle and three upper ribs, and a large ventral hernia in the left iliac fossa. On May 9 I

performed a partial excision of the clavicle and three upper ribs. Eight days later I exposed the ventral hernia through a three-inch transverse incision. The peritoneum was not opened. A silver wire filigree two by three and a half inches was placed between the peritoneum and the transversalis. The external oblique was approximated with a running suture of silver wire, and the skin with silk. The wound healed by primary union, and the man has suffered no discomfort from the wire.

CASE V.—Tony M., 24 years old, admitted July 10, 1905. In 1901 the girl had been operated on for appendicitis. A year later a hernia developed in the scar; it had always been reducible until two weeks before admission. At that time the mass suddenly increased in size, the bowels could not be moved and vomiting set in. The hernia was five inches wide and three inches long. On the surface of the mass there were several small ulcers. Operation, July 12, 1905. Hernioplasty with resection of gut for large ventral hernia with gangrene of gut. The hernia was found to consist of several loops of firmly adherent small intestine. One loop had perforated the skin and formed the large ulcer on the surface of the skin. On account of its poor condition six inches of this loop, together with the adherent skin, were resected. End-to-end anastomosis with the Connell suture was done. The circulation in the adjacent portion of the gut was none too good, and accordingly two pieces of rubber dam were placed around the suture line. As the patient's condition was not very good, and as the operation had already consumed considerable time, it was decided to use silver wire to close the abdominal wall. The hernial ring was freed as well as possible and through-and-through silver-wire sutures were passed from side to side. In this way the greater part of the opening was closed. The rubber-dam drains emerged at the centre of the ring. The skin was sutured with silk. For two weeks there was a fecal discharge from the wound. Thereafter the wound healed steadily, and the patient left the hospital with a completely healed wound on August 16, 1905. Since then the girl has been doing arduous housework, including the lifting of heavy weights and the scrubbing of floors, without any pain or discomfort.

CASE VI.—Golde B., 30 years old, admitted October 3, 1905. The patient had an umbilical hernia of five years standing. Five

days before admission the hernia for the first time had become irreducible. The bowels could not be moved, and vomiting set in. The hernia was the size of an orange, tense and tender. Operation on October 3, 1905. The sac was filled with omentum and one loop of small intestine. The intestine was replaced and the omentum resected. Three sutures of silver wire almost completely obliterated the diastasis at the neck of the sac. A few catgut sutures approximated the superficial tissues. A small cigarette drain was introduced and the skin sutured with silk. The wound was entirely healed in sixteen days. It would not have been possible in this case to have brought the fascia together in any other manner. Three months later after a severe attack of bronchitis the patient developed a small hernia just below the umbilicus. Had I put in a filigree besides the silver-wire sutures, this would not have occurred.

CASE VII.—Mary M., 27 years old, admitted October 3, 1905. Two weeks before admission the woman noticed a mass in the right hypochondrium and epigastrium. The mass was hard, smooth, adherent to the abdominal wall, and measured about three by five inches. On January 31, 1906, the tumor was excised through a vertical incision in the right hypochondrium. The tumor involved the right rectus and the adjoining portions of the oblique muscles; it was also adherent to the parietal peritoneum. Portions of the oblique muscles, the rectus together with both its sheaths, and the adherent peritoneum, were removed with the tumor in one piece. It was only with difficulty that the peritoneum could be brought together with catgut sutures. A filigree was then placed in the depth of the wound, and a second filigree made by passing running sutures of silver wire through the oblique muscles. A drain was introduced at either angle, and the skin approximated with zinc oxide plaster. Recovery was uneventful. The pathologist of the hospital, Dr. Mandlebaum, reported the tumor to be an inflamed fibroma.

The writer believes it can be safely said that if the silver-wire filigree be correctly made and correctly introduced, it will seldom be necessary to subsequently remove it. If, furthermore, the precaution be taken of introducing two separate

filigrees in different planes, then the large majority of otherwise inoperable herniæ will be radically cured. With careful attention to a few technical details we have in the use of the filigree a rapid, safe, and efficient method of curing large herniæ, and one that deserves, in properly-selected cases, the hearty approval of every surgeon.

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PRIMARY TUMORS OF THE URINARY BLADDER.

A STUDY OF FORTY-ONE CASES AT THE MASSACHUSETTS GENERAL HOSPITAL.*

BY LINCOLN DAVIS, M.D.,

OF BOSTON, MASS.,

Out-Patient Surgeon, Massachusetts General Hospital; Instructor in Anatomy, Harvard Medical School.

THE cases which form the basis of this paper are taken from the clinical records of the Massachusetts General Hospital since 1877, and the autopsy records since 1897. There are included in this series of forty-one cases only primary tumors of the bladder which have been verified by either operation or autopsy. Many cases in which the diagnosis was made by the presence of villous fragments in the urine, or from clinical symptoms, or by the cystoscope, but which for various reasons did not come either to operation or autopsy, are not included. Neither are numerous cases of malignant disease of the bladder, obviously secondary to cancer of the uterus, prostate, or intestines, included.

The object of this study has been:

First. To record such clinical data, as the analysis of a considerable number of cases affords, with special reference to end results after operation.

Second. To investigate the pathological anatomy of the simple epithelial tumors of the bladder, commonly called papillomata, with relation to the ultimate prognosis.

To this purpose the hospital records have been carefully analyzed, and after persistent search, reliable information as

* For the privilege of reporting these cases I wish to acknowledge the courtesy of the Visiting Staff of Surgeons of the Hospital. I also desire to thank Dr. W. F. Whitney, Surgical Pathologist, and Dr. J. H. Wright, Director of the Clinico-Pathological Laboratory, for the use of their valuable material and for kind assistance.

to the histories of patients after discharge from the hospital have been pretty generally obtained; personal interviews were possible in a few cases. All the pathological specimens which were preserved have been reëxamined, and studied in relation to each other, and to the clinical course of the disease.

In thirty-seven of the forty-one cases included in this report, the tumors were removed by operation; in the remaining four cases the condition was found at autopsy. A summary of the cases in the form of a table follows at the end of this article.

ETIOLOGY.

Prevalence.—The fact that in the twenty-eight years since 1877 only thirty-seven cases of primary tumors of the bladder have been operated upon at this hospital, leads one to believe that the disease is a comparatively rare one, at least in this locality.

It is interesting to note that in the same period of time there have been four hundred and forty-two cases of stone in the bladder operated upon. This comparison, however, is not strictly fair, for it is reasonable to suppose that a greater number of cases of tumor than of stone have been overlooked, since the diagnosis of the former condition was, until the perfection of the cystoscope within recent years, rather uncertain, while a perfectly adequate method of diagnosticating stone has been known for years. Then, too, doubtless in the earlier years, on account of the greater formidableness of the operation for tumor as compared to that for stone, some of the former cases even if diagnosticated may not have been attacked.

By decades the cases of tumor group themselves as follows: 1877–1887, 5 cases operated on; 1887–1897, 14 cases operated on; 1897–1905, 18 cases operated on. The increase since 1897 is not striking, considering the improved methods of diagnosis and operative technique.

That the disease is generally considered a rare one is shown by the much-quoted figures of Küster, who found 10

cases out of a total of 3938 cases of tumors of all kinds operated upon at the Augusta Hospital in Berlin, ¼ of 1 per cent. Gurlt collected 66 cases out of 16,637 cases of tumors in 3 large hospitals in Vienna, less than 0.4 per cent.

Albarran, on the other hand, maintains that tumors of the bladder are far from rare, and cites the fact that in Guyon's ward at Necker in 4 years there were 55 vesical tumors, or 3.9 per cent. of all genito-urinary cases there treated.

Sex.—In this series of cases there were 7 females and 34 males, an excess of males slightly less than that reported in other collections of cases. Albarran's figures are 14 per cent. of females in 381 cases. Nitze's figures show a still smaller percentage of females.

Age.—The age at which the patients entered the hospital with the disease has been noted. In decades the cases group themselves as follows: Under 20 years, 1 case; 20–30, 2 cases; 30–40, 2 cases; 40–50, 5 cases; 50–60, 21 cases; 60–70, 7 cases; 70–80, 8 cases. This shows a marked preponderance of cases in the sixth decade, a fact generally noted. The youngest patient was 16 years old, a case of sarcoma; the oldest 73. The average age was 53.

Excluding two comparatively rare forms, myxoma and sarcoma, which occur in childhood, the first exclusively and the second commonly, tumors of the bladder in general, although occurring throughout adult life may be said to essentially belong to the period of middle life, and early old age.

Cause.—The direct cause of tumors of the bladder as of tumors elsewhere in the body is not known. The frequency with which certain cell inclusions have been found in the epithelial tumors of the bladder, has led to considerable discussion of the parasitic theory in connection with their origin.

According to the weight of best authority, however, these cell inclusions can be adequately explained as the products of either cell activity or degeneration, as the case may be, and the parasite remains to be actually demonstrated.

Of predisposing causes several have been advanced from

time to time and seem to have more or less weight. Chief of these is irritation (chemical, mechanical, or bacterial).

That chemical irritation of the bladder has some relation to the formation of bladder tumors seems to be borne out by the prevalence of this condition among workers in aniline factories. A striking number of such cases have been reported by Rehn, Leichtenstern, and Huldschiner. It cannot be doubted, it seems to me, that there is here something more than mere coincidence. That it is more than a contributing factor, however, cannot be claimed in view of the small proportion of cases to which it applies relative to the total number of bladder tumors.

In this series of cases chemical irritation of the bladder seemed to play no part in the causation of the disease, so far as an investigation of the occupations of the patients could determine this point. The occupations were various, and diverse, including all the ordinary vocations of life; sea-faring men, of whom there were five, were for some unaccountable reason in the majority.

The mechanical irritation of stone in the bladder has been considered an etiological factor of importance. Rosenow has collected from the literature 44 cases in which stone was associated with tumor. From a study of the clinical history and post-mortem findings of these cases, he reasons that the stone was primary in 18 cases, and the tumor in 8. He concludes "that contrary to the views of Neelsen, Busse, and others, an etiological relationship between calculus and tumor is not to be denied altogether, and calculus seems to favor the development of tumor in a larger percentage of cases than tumor favors the development of stone."

The latter part of this conclusion is not only contrary to the views of the authors quoted above, but is at variance with the opinions of such authorities as Guyon, Albarran, and Nitze. The former says that it can be affirmed that preceding diseases of that organ (the bladder) or of the urethra, such as gonorrhœa, stricture, cystitis, stone, retention, hypertrophy

of the prostate predispose to tumors of the bladder in no way. Nitze makes a statement to the same effect.

Furthermore, there is considerable evidence that tumor does favor the development of stone in many cases, the secondary changes in the bladder which inevitably sooner or later result from the presence of a tumor, such as inflammation, ulceration, retention, etc., furnishing the very conditions which are most favorable for the formation of a calculus.

The well-known frequency of calcareous incrustation of tumors is evidence of this tendency. It is merely a further step in the same process to the formation of a true calculus about a detached fragment of tumor, and such cases have been reported.

An investigation of cases in this hospital with reference to the association of stone and tumor may be of interest. It is a striking fact that of the 438 individuals who underwent 492 operations for stone in the bladder since 1872, only one (Case XVIII) according to the records, subsequently developed a tumor of the bladder. If others did so the condition was either unrecognized, or treated elsewhere. Among this number there were many cases of recurrent vesical calculi with repeated operations, which were doubtless subjected to the "irritation of stone" in no small degree. It must in fairness be said, however, that in a number of these cases of recurrent vesical calculi there was enlargement of the prostate gland, and that in at least one of them, possibly more, it was afterwards discovered that the gland was carcinomatous. Such cases not being primary tumors of the bladder, are not included in this series, but are mentioned as possibly throwing some light on the difference of opinion which exists as to the association of stone and tumor.

Of the forty-one cases of primary tumors of the bladder, in addition to Case XVIII, already mentioned, there were 7 cases in which there was an association either past or present with true calculus or deposition of urinary salts.

These cases, Nos. I, IV, XV, XVIII, XXIII, XXIX, XXXI, and XXXVI, may be briefly summarized as follows:

CASE I.—A villous tumor of the bladder incrusted with urinary salts was removed by Dr. Warren. No history of previous stone. Death 14 years later. Cause of death recorded in Massachusetts Archives as "renal calculi."

CASE IV.—Service of Dr. Bigelow. Urinary symptoms for 8 months, with hæmaturia for 2 months. At operation a lithotrite was introduced into the bladder and what seemed to be a soft stone seized and crushed. The evacuator brought out some fragments of stone with blood-clots. A vaginal cystotomy was then done, and a tumor the size of two English walnuts removed from the bladder. The patient died at the end of 7 days.

CASE XV.—This case has been reported in detail by Dr. A. T. Cabot.[1] A brief résumé follows here:

In 1870, in another city, the patient was cut for stone by the lateral perineal route. Frequency of micturition persisted ever after this. In 1884 there was a sharp attack of cystitis, and five years later fragments of stone were passed. In September, 1889, the patient entered the hospital; the bladder was searched for stone, washed out with the Bigelow evacuator, and several small fragments composed of papillary masses of epithelial cells mixed with urinary salts came away. Suprapubic cystotomy was then performed by Dr. Cabot, and a thick, flat, cutaneous-looking sheet of tissue removed from surface of bladder,—"Pachydermia vesicæ."

In March, 1892, the patient began to have pain in the bladder and frequent micturition again. In July, 1894, he reëntered the hospital with a discharging sinus above the pubes. The sinus was enlarged by Dr. Cabot and the interior of the bladder explored: it was found invaded by a new growth. A small portion which was removed proved to be epidermoid cancer. The patient died a short while later, and at autopsy the bladder, as well as the kidneys, muscles of abdominal wall and retroperitoneal glands, were found to be involved in the disease.

[1] Papers on Genito-Urinary Surgery. "A case of cystitis with formation of a thick epidermal sheet in the bladder,—Pachydermia vesicæ."

CASE XVIII.—This case also has been reported by Cabot[2] There was a history of stricture of the urethra, for which no operation was done. Six years later, after an attack of renal colic (?), a few small, pea-sized stones were passed. Eight years later, symptoms of cystitis developed, which steadily increased for a year, until a small stone in the bladder was crushed by Dr. Cabot in 1895. In the course of a few months there were two recurrences of stone, for which there was no apparent cause, as the bladder emptied itself and the urine was acid. In November, 1895, the bladder was opened above the pubes by Dr. Cabot; a stone was removed from the postprostatic pouch, and a little myoma with ulcerated, granulating surface, incrusted with urinary salts was removed. There was no recurrence of symptoms for 2 years. History after this time not known.

CASE XXIII.—Service of Dr. Elliot. Symptoms of cystitis with hæmaturia following confinement 2 years before. Passed several small stones during the preceding year. In May, 1900, the urethra was dilated and two small tumors removed from bladder. In December of the same year she reëntered the hospital with the same symptoms, and a history of having passed blood and some stones. A suprapubic cystotomy was done by Dr. Greenough. A deposit of calcareous matter was curetted off the bladder wall, and two papillomatous masses removed. No history subsequent to the discharge from the hospital could be obtained.

CASE XXIX.—Hæmaturia of 3 months' duration. Papillary tumor incrusted with urinary salts removed by suprapubic cystotomy by Dr. Cabot. No urinary symptoms 2 years later.

CASE XXXI.—Operation 31 years ago at the age of 9 for stone in the bladder. No urinary symptoms from that time until the beginning of the present trouble, 3½ years ago, when he first noticed bloody urine which has persisted intermittently since. In February, 1904, a papillary tumor of the bladder was removed by Dr. Cabot. No stone. In August of the same year he returned to the hospital with recurrence of symptoms. The bladder was reopened by Dr. Conant and found studded with nodular growths, which were curetted out and cauterized. He left the hospital

[2] Papers on Genito-Urinary Surgery. "Observations upon stone in the bladder."

somewhat relieved. Death from the disease ensued two months later.

CASE XXXVI.—A large fibro-myo-sarcoma removed by Dr. Balch, the lower portion of the growth was incrusted with urinary salts.

Of these 8 cases there were 4 (Cases I, IV, XXIX, and XXXVI in which there was not true stone formation, but incrustation of existing tumors with urinary salts. In these it is evident that the tumor was the primary factor.

In 2 cases (Nos. XVIII and XXIII) it is not possible to determine which was the primary etiological factor. In Case XVIII, the probability of the early stones having favored the development of the tumor, a myoma, is at least offset by the contrary evidence that the late ones were the result of it. Case XXIII is inconclusive through incompleteness of subsequent history.

Two cases (Nos. XV and XXXI) in which the stone was unquestionably primary in point of time, remain to be considered. Case XV was complicated by the rare condition of pachydermia vesicæ, which is of notoriously slow development, and therefore very likely may have antedated both conditions, the persistence of the bladder-symptoms after removal of the stone giving color to this view. Be that as it may, there are at least as good grounds for attributing the tumor, which was epidermoid cancer in this case, to a malignant transformation of the leukoplakia, as to the direct result of a single stone removed 24 years previously.

Hallé, who reported 7 personal cases of leukoplakia of the bladder, in 1896, advanced the theory of the malignant degeneration of this condition. He supported his theory on the evidence of one of his own cases, in which the coexistent lesions of leukoplakia and cancroid were found, and also on the analogy of a similar tendency in leukoplakia of the mouth.

Of Hallé's 7 cases it is interesting to note that 4 were associated with stone; in 3 of these the stone was evidently secondary in origin, in the fourth case this point could not be determined.

CASE XXXI.—There can be no question but that the calculus was primary in this case, the interval of 26 years, however, between the removal of the stone and the onset of tumor symptoms,—an interval characterized by the entire absence of all bladder symptoms,—makes it hard to believe that "irritation" played an important part in the causation of the tumor.

Among these cases should be mentioned for the sake of completeness 2 cases (Nos. XXXII and XXXVIII) in which the patients gave a history of having passed gravel, respectively, 1 and 2 years previous to entrance to the hospital. In neither of these cases was stone or deposition of urinary salts found in the bladder. The unconfirmed observation of a patient as to the passing of gravel is liable to too many sources of error to be accepted without scepticism, and therefore it seems not worth while to consider these 2 cases further.

As far then as an analysis of these cases goes, it may at least be said that no strength is added thereby to the irritation-of-stone theory.

Under the head of mechanical irritation should be mentioned the effects of the distoma hæmatobium. The occasional association of papilloma, carcinoma and sarcoma with Bilharzia disease of the bladder has been reported by Goebel. Zuckerhandl, in his "Handbuch der Urologie," pictures very beautifully a "Bilharzia papillom" showing numerous calcified distoma embryos in the stroma of the tumor. This source of irritation, like the aniline poisoning, is of great interest, but is necessarily restricted to a very limited field and lies outside the scope of this paper.

Bacterial irritation of the bladder as in cystitis, enlarged prostate, etc., may be dismissed as of no real importance in the causation of bladder-tumors, except possibly in the rare instances of epidermoid cancer. In only a small proportion of cases in this series was there any history of urinary disturbance antedating the symptoms which could be properly ascribed to the tumor itself.

Early gonorrhœa had been present in 6 cases. No sequelæ of that disease were mentioned in the histories except in one case, where stricture of the urethra had been present 15 years previous to the tumor.

In 16 cases it was stated that there never had been gonorrhœa. In 19 cases there were no data as to this point.

Symptoms of cystitis,—that is, frequent and painful urination,—were the first complaints in 15 cases, but the cardinal symptoms of tumor, hæmaturia, followed shortly in all; the only exceptions being Case XVII in which there was a period of 5 years characterized by frequency of micturition and scalding before the onset of hæmaturia; Case XVIII, a myoma, in which hæmaturia was never noted; and Case XL, in which there had been recurrent attacks of pain in the left kidney region for 20 years preceding the occurrence of blood in the urine.

The cases in which there was a previous history of stone have already been detailed.

In the remaining 20 cases hæmaturia was the first urinary symptom noted.

PATHOLOGY

In 28 of the total of 41 cases, microscopical examination of the tumors removed were recorded. According to these reports there were 15 cases of cancer, 10 of papilloma, 2 of sarcoma, and 1 of myoma. Under the first heading were included such varieties as infiltrating cancer, epithelioma, villous and papillary carcinoma, adeno-carcinoma, mesothelial cancer, and epidermoid cancer. Under the heading "Papilloma" were included 4 cases designated as malignant papilloma, one case as probably malignant, and 2 cases in which the question of malignancy could not be determined from the specimen. Of the 2 sarcomata, one was a round-cell variety, the other a fibro-myo-sarcoma. There were 3 cases in which secondary operations were done for recurrent tumors; in one case the recurrent growth was reported to be of the same nature as the original,—viz., cancer; in another a

papillary cancer was reported to have recurred as a papilloma, and in a third an epithelioma as a carcinoma.

To the multiplicity of terms employed by different investigators with regard to the epithelial tumors of the bladder, are to be attributed seeming discrepancies, which are more apparent than real, but which are nevertheless confusing.

How shall a malignant papilloma be distinguished from a papillary cancer, or an epithelioma from a papilloma, or carcinoma?

Recourse to the literature does not dispel this confusion, as a most varied nomenclature and classification of these growths has been adopted by different authorities. With the hope of clearing away the confusion on this subject in my own mind at least, a careful study has been made of the pathological specimens which had been preserved in 19 cases, and were kindly placed at my disposal.

Classification.—It seemed necessary at the outset to adopt a classification for these tumors. That proposed by Küster, based on histological structure, dividing tumors of the bladder into 3 groups according to the 3 elements of the bladder-wall, —epithelial, connective tissue, or muscular,—from which their principal elements are derived, is the simplest and perhaps the most generally accepted. This has been followed with one radical change in interpretation for which there is good authority, namely, the transposition of the papilloma (Zottenpolyp of Küster) from group 2 to group 1. With this change the classification stands as follows:

1. Epithelial group	papilloma carcinoma adenoma cysts
2. Connective-tissue group	sarcoma myxoma fiibroma angioma
3. Muscle group	myoma

This is essentially the classification of Albarran reduced to its simplest terms. It does not include certain rare forms of bladder tumors such as rhabdo-myoma, chondroma, and dermoids, which are not derived from any normal elements of the bladder-wall, and for which Albarran makes another class under the name "Heterotopic." As none of these rare forms was observed they are mentioned only to be dismissed from further consideration.

Papilloma.—The term "papilloma" has been retained in this classification, objections on the score of ambiguity of the word being outweighed by the sanction of long usage in English medical literature. The term as here used refers to a pedunculated papillary or villous tumor consisting of a branching connective-tissue stalk, containing blood-vessels and occasionally smooth muscle-fibres, covered with one or more layers of epithelial cells, but without epithelial infiltration of the bladder-wall. This tumor is classed under the first or epithelial group, as the epithelial element in it is regarded as the essential one. There are, however, great variations in the proportions of epithelium and connective tissue in different specimens. All gradations occur from the tumor in which the connective tissue forms a thick and massive stalk with but a thin covering of two or three layers of epithelial cells, a form which is hardly to be differentiated from the pure fibroma, to that in which the connective tissue is reduced to a mere line threading its way brokenly between masses of epithelial cells packed in countless layers.

Yet in the main two types of papilloma stand out as fairly distinct, the villous and the lobulated. The villous type, "fimbriated papilloma" of Sir Henry Thompson, is characterized by the delicacy and tenuity of its connective-tissue processes, which spring like a tuft of grass from a circumscribed base. The structure of the tumor is so delicate that it collapses into a soft mass when exposed to the air, and it is only when observed in a fluid medium that its slender filamentous nature is appreciated. Microscopically the epithelial covering is

usually comparatively thin, comprising but a few layers of cylindrical cells. By some observers this variety is regarded as merely an early stage in the development of the second type, the lobulated papilloma, "fibro-papilloma," of Thompson. In the lobulated papilloma the connective-tissue stalk is thicker and more branching, and the epithelial covering also, as a rule, considerably thicker, so that the tumor has a firmer consistency and retains its shape when removed, resembling closely a miniature cauliflower.

There may also be marked divergence from the normal type on the part of the epithelial cells in these tumors, as to size, shape, and arrangement, so that some of these papillomata may present most atypical or malignant aspects, so-called transitional forms, which are only to be differentiated from the true carcinoma by the absence of epithelial invasion of the bladder-wall.

There being then such variations in the structure of this form of tumor, it is but natural that there should have been much confusion as to its terminology and classification. The terms, "fungus" of early authors, "zottenkrebs" of Rokitansky, "Fibroma papillare" of Virchow, "papillary epithelioma" of Zeigler, "zottenpolyp" of Küster, "fimbriated" and "fibro-papilloma" of Thompson, and "villous tumor" of many writers, all refer to this same growth, and illustrate well enough the different points of view from which it has been regarded. Nitze, though retaining the term papilloma, follows Virchow and Küster in classifying it as a connective-tissue tumor.

Carcinoma.—There is corresponding confusion on the subject of primary carcinoma of the bladder, particularly in regard to that form commonly called papillary or villous carcinoma, which is generally conceded to be the most prevalent variety. There has been and still is great divergence of opinion among authorities as to what constitutes a papillary carcinoma of the bladder. Rokitansky held that all papillary epithelial tumors of the bladder were malignant, and designated

them as zottenkrebs. This view is still held to a certain extent. Virchow was the first to emphasize the fact that benign "papillary fibromas" did occur. The existence of benign epithelial tumors of the bladder has been amply confirmed since.

Albarran distinguishes two forms of epithelial tumors of the bladder according to the type of their epithelial coverings, —the benign papillomata, or (as he prefers to call them) "polyps bénins," and the malignant epitheliomata. If the type of the normal epithelial cells of the bladder is reproduced, then the tumor is a papilloma; if the cells are, on the other hand, atypical, then the growth is an epithelioma.

Other authorities, notably Orth and Ziegler, make epithelial infiltration of the bladder-wall, and the formation of metastases, the distinctive sign of a carcinoma in this locality as elsewhere.

The fact, which is pretty generally recognized, that a benign papilloma may undergo carcinomatous degeneration, makes it evident that there must be a stage in this process when it will be exceedingly difficult, if not impossible, to determine whether a growth is benign or malignant; the term "transitional" has been applied in such cases. This tendency of papillomata to malignant degeneration will be considered in more detail later.

It is also a generally-conceded fact that of two tumors which are otherwise macroscopically and microscopically indistinguishable, the bladder-wall may show epithelial infiltration in one, and not in the other.

Under these circumstances it seems requisite for the sake of clearness and uniformity in differentiating these papillary growths, that the condition of the underlying bladder-wall in regard to epithelial infiltration should be made the crucial test of malignancy, rather than the character and arrangement of the cells in the growth itself. The former criterion is definite and precise, and even if its application is not possible in all cases of operative removal of the tumors, is, nevertheless, to be preferred to one which, although possessing a wider range

of application, is so indefinite and subtle, and subject to such latitude of personal interpretation, as to surely lead to differences of opinion.

Other forms of carcinoma, such as the diffuse or nodular infiltrating growths, are distinctive and offer no difficulties in recognition.

Relative Frequency of Papilloma and Carcinoma.—As the result of differences of definition among authorities, there are widely divergent views as to the relative frequency of papilloma and carcinoma.

Albarran may be quoted as an exponent of the view that malignant growths greatly predominate. He records 81 epithelial tumors of the bladder which were histologically studied by himself. Of these, 13 in which the epithelium was considered typical, were classed as papillomata, and 68 in which it was atypical, were classed as epitheliomata, without reference to the question of infiltration of the bladder-wall. The word epithelioma is here used, according to the custom in France, as indicative of malignancy.

Nitze, who upholds the contrary view, mentions 220 cases of his own which were anatomically studied. Of these 144 were papillomata, 64 carcinomata, 2 adenomata, 7 sarcomata, and 5 myxomata.

Küster was the first to point out a source of error which doubtless led many observers to consider as malignant, papillary tumors which were really benign. This was the appearance of masses of epithelial cells surrounded by a connective-tissue framework which might give at first the impression of alveolar carcinoma, but which a closer study, especially of serial sections, revealed as folds between the papillary processes, cut in such a manner as to produce this effect. Another source of error which has been pointed out by Colley is the possibility of fragments of epithelial cells broken from the delicate villi of the tumor in the process of preparing the section, becoming transposed to other portions of the section, where they may be regarded as evidences of metastases. I

have frequently observed little clumps of epithelial cells scattered about the edges of the tumor, at the base, as well as on the surface, which I have regarded as due to this cause.

With this preliminary clearing of the path, we may proceed to a consideration of the cases in hand.

Analysis of Cases.—Specimens were personally examined in 19 cases; of these 17 belonged to the epithelial group, with which this analysis is particularly concerned.

In 6 of these 17 cases there was satisfactory evidence, either microscopical or macroscopical or both, of epithelial invasion of the bladder-wall. These cases were, therefore, regarded as carcinomata.

In 7 cases the specimens allowed of a more or less complete examination of the underlying bladder-wall, which was found to be free from epithelial infiltration. These cases were, therefore regarded as papillomata.

In the 4 remaining cases the specimens did not contain any portion of the bladder-wall. So that the question of epithelial infiltration could not be determined by the microscope in them. Neither was there macroscopical evidence of infiltration at the time of operation. These cases must be considered doubtful, then, as far as this test goes. It is in such cases that the structure of the tumor itself, and particularly the type and arrangement of the epithelial cells, offer a clue of more or less value as to the benign or malignant nature of the growths. On these grounds, which have already been characterized as unsatisfactory, these 4 cases have been tentatively classed among the papillomata.

Cases of Papilloma.—The specimens in the 4 doubtful cases (Nos. XX, XXI, XXVI, XXXV) may be briefly described as follows:

Case XX.—The specimen in this case was a papillary growth the size of a chestnut, which on section showed a pedicle, without bladder-wall, from which sprung a rather coarse, branching, vascular, connective-tissue framework, markedly infiltrated with round cells and covered by a many-layered epithelium of fairly regular type, and not excessive

thickness. The line of demarcation between epithelium and connective tissue was fairly sharp. No mitoses were observed.

CASE XXI.—The specimen, one of two similar ones removed, consisted of a papillary growth of about the same size as the preceding one, showing none of the bladder-wall. The branching connective-tissue stroma was slight and exceedingly vascular. The epithelial covering was of considerable thickness in places, and here and there were clusters of epithelial cells in a concentric arrangement forming epithelial whorls. Line of demarcation not everywhere sharp; no mitoses. (See Figs. 4 and 5.)

CASE XXVI.—The section was of a papillary growth, somewhat larger than the two preceding, showing a number of branching stalks springing separately from a common base, composed of connective tissue without muscle-fibres. The papillary processes consisted of a central branching stalk of connective tissue of some thickness, containing blood-vessels clothed with a many-layered epithelium which, for the most part, did not greatly exceed in thickness the width of the stalk. The epithelial cells were of large size and quite uniform, cylindrical at the base, becoming cuboidal at the surface, disposed in layers, 12 to 30 in number, approximately. They presented a regular and typical arrangement. Mitoses were however, strikingly numerous. The line of demarcation between epithelium and connective tissue was particularly clear cut. There was some small cell infiltration of connective tissue of base and a number of plasma cells. (Fig. 6 and 7.)

CASE XXXV.—Sections consisted of fragments of a papillary tumor the size of a pigeon's egg (Fig. 1), showing neither base nor bladder-wall. The delicate connective-tissue stroma was covered with a many-layered epithelium of very considerable thickness. The cells were of fairly large size and were so closely packed together in places as to partially obliterate the spaces between neighboring papillary processes. Occasional mitoses were observed. The line of demarcation between epithelium and connective tissue was sharp.

In the sections of all these cases there were masses of epithelial cells entirely surrounded by a connective-tissue stroma; these are all, however, susceptible of Küster's explanation. In Cases XX and XXVI there were small clumps of epithelial cells scattered about the edges of the specimens, at the base as well as at the surface; these were considered to be the result of trauma to the specimen after its removal.

It would surely be difficult to draw accurate differential conclusions as to their benign or malignant character from the histology of these specimens. Of the four, No. XXVI, except for the number of mitoses, showed the most typical epithelium.

Fig. 1. Lobulated papilloma natural size (Case XXXV).

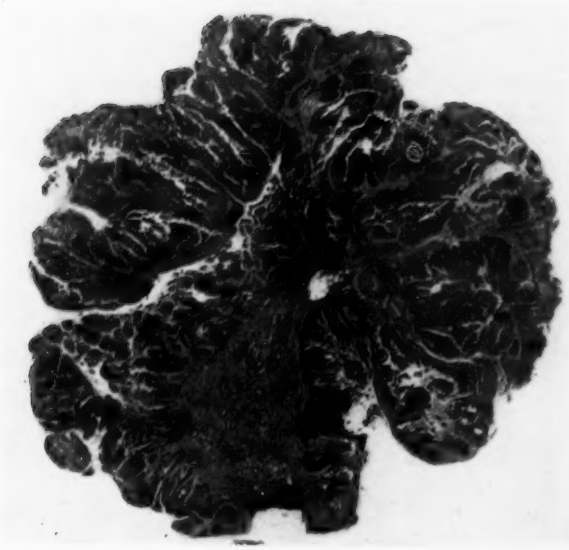

Fig. 2. Section of a lobulated papilloma x 4 diameters (Case XXXVII).

Fig. 4. Section of lobulated papilloma x 5 diameters (Case XXI). This was a recurrent growth removed 8 years ago, with no subsequent recurrence.

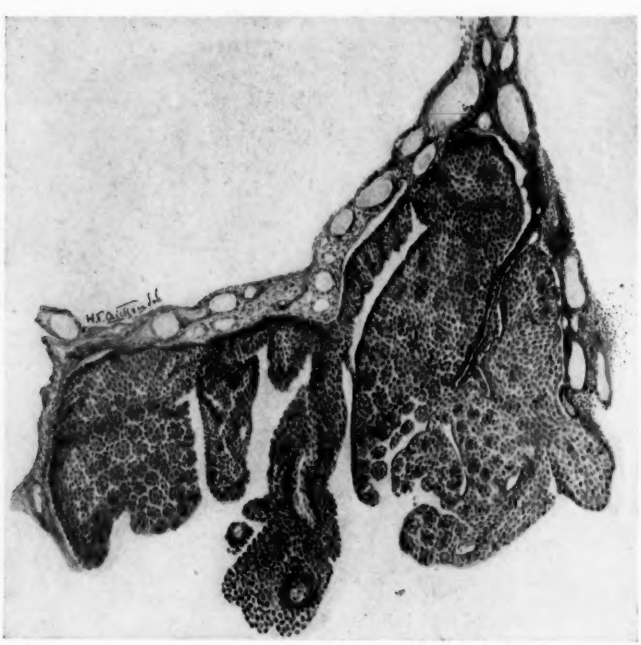

Fig. 5. Low-power drawing of detail of same at point marked by arrow. Shows vascularity of connective tissue stalk, and comparative thickness of epithelial covering, which has been drawn on one side of the stalk only. The concentric arrangement of the epithelial cells in small clusters is quite striking.

Fig. 6. Section of papillary epithelial tumor x 5 diameters (Case XXVI). In this case there was recurrence with death from the disease.

Fig. 7. Low power drawing of detail of same at point marked by arrow, showing regularity of epithelium and sharp line of demarcation between it and connective tissue stroma. The mitoses which were strikingly numerous are not shown.

What light does the clinical history of these cases after operation throw on this question?

In Case XX, eighteen months after the operation, death resulted from another disease without recurrence of bladder symptoms. In Case XXI, there have been no signs of a recurrence in the 8 years which have elapsed since the operation. In Case XXVI, there was a recurrence and a second operation, 18 months after the first, with death from the disease 2 months later. The histology of the recurrent growth will be considered under another heading. In Case XXXV, there were no bladder symptoms for 4 months after operation. No news since.*

Clinically then, one case (No. XXI) seems to have been proved benign. Another (Case XX) also probably benign. One case (No. XXVI), to be further considered later, may have been malignant from the first, but it is not necessarily so, and one (No. XXXV) still doubtful.

In 4 cases (Nos. XXIX, XXX, XXXIII, and XXXVII) the specimens removed contained portions of the bladder-wall including muscularis; careful examination of these failed to reveal evidences of epithelial infiltration in any. These specimens were of a similar nature to those already described; the first 3 of them, however, showed a greater proliferation of epithelium and a less typical arrangement, in fact a more malignant aspect, than any in the first group.

CASE XXIX.—A papillomatous tumor the size of the end of a finger was removed from the bladder with the cautery, including a margin of healthy mucous membrane and a considerable extent of bladder-wall, including the muscularis. The tumor was incrusted with urinary salts. Doubtless owing in part to the escharotic effect of the cautery, and also on account of the necessary removal of the incrusted portions, the specimen was rather imperfect and confusing. A main stalk of considerable

* This patient reëntered the hospital Feb. 5, 1906, with history of slight hæmaturia for 4 months. I did a suprapubic cystotomy and removed the prostate which was regarded as suspicious of malignant disease; there was no sign of a recurrence of the papilloma. Microspical examination of the prostate showed simple hypoertrophy. The patient is now convalescing.

thickness could be made out, from which there were very fine lateral offshoots, covered with an extremely thick layer of epithelium. The epithelial cells were quite variable in size and shape, and showed in places a very irregular or atypical arrangement. There were occasional mitoses. The line of demarcation was not everywhere sharp between the epithelium and connective tissue of the stalk. There was marked round cell infiltration of the stalk. The bladder wall itself showed no epithelial infiltration.

CASE XXX.—Section of a papillary growth 2x3 cm., with a portion of the base and muscularis of bladder-wall; there were a number of long, slender connective-tissue stalks covered with an exceedingly thick layer of epithelial cells. The villous processes in places were fused. The arrangement of the epithelial cells varied considerably in different parts of the growth, being in places quite typical, in others quite atypical. A number of mitoses were observed. The line of demarcation was not sharp; no epithelial infiltration of bladder-wall. There was an opportunity to examine the bladder two days later at autopsy in this case. A partial prostatectomy for adenoma of the prostate had been done at the same time that the papilloma was removed. The bladder was found to contain much clotted blood, with hemorrhagic infiltration of the tissues about the bladder. On the mucosa of the posterior bladder-wall there was a small shaggy mass with a short pedicle. The bladder wall at the site of removal of papilloma showed some thickening. Microscopic examination, however, according to the autopsy report, showed no evidence of carcinoma. This section could not afterwards be positively identified. The section of the small papilloma, found at autopsy, showed a papillary excrescence not larger than a pea, which was partly denuded of epithelium. The epithelium where it existed was disposed in few layers. Lying on the connective-tissue stroma just below the surface and in places communicating with the surface, were clumps of epithelial cells, some of which contained open spaces in the centre, giving to them a glandular appearance. There was no epithelial infiltration of the bladder-wall at the base of the tumor. The section corresponded closely to what Zuckerkandl has described and pictured as cystic papilloma.

CASE XXXIII.—The specimen consisted of a pedunculated growth, 6 cm. in greatest diameter, which was removed from the bladder together with a considerable extent of underlying bladder-wall, including its muscularis. Microscopically the growth consisted of a number of long, slender stalks which were extremely vascular, radiating outwards from a circumscribed pedicle. These stalks were clothed with an epithelial covering of great thickness which consisted of large epithelial cells, varying considerably in size and arrangement.

In places the cells were packed together very closely, neighboring villi becoming fused and the papillary structure lost. In other places the arrangement was quite typical. Mitoses were rare. Line of demarcation between epithelium and connective tissue fairly sharp. There were evidences of intense inflammation of the bladder-wall, with round-cell

infiltration. Absolutely no epithelial infiltration. The specimen is very like that in Case XXX.

CASE XXXVII.—In this case two tumors were removed from the bladder, one the size of a pigeon's egg on the right margin of the trigonum, and another smaller growth, size of a large pea, on the posterior wall above trigonum.

The larger section showed a papillary tumor with its pedicle but without bladder wall. (Fig. 2.) The stalk was comparatively coarse and contained muscle-fibres. The epithelium, less thick than in many of the preceding specimens, was composed of small, strikingly uniform, cylindrical cells, sharply marked off from the connective-tissue stroma. No mitoses were observed. The smaller specimen was of the same character, showing a good portion of the bladder wall without infiltration. Serial sections were made of both these specimens, but beyond demonstrating the fact that masses of epithelial cells, apparently enclosed in a connective-tissue stroma really were a part of the surface epithelium, showed nothing.

Clinically, in Case XXIX, there is perfect health 2 years and 2 months later. Case XXX has no clinical after-history; the histological evidence of benignity of the growth, is, however, quite complete.

In Case XXXIII there is perfect health one year later. Case XXXVII is too recent to be considered.

It would be premature to draw conclusions from these histories, but it may be said that, as yet, the histological findings have not been belied by the clinical data.

In 3 cases (Nos. XXXVIII, XXXIX, XLI) the specimens were obtained at autopsy, and cut together with a portion of the bladder-wall to which they were attached. In these cases an excellent opportunity was afforded to examine the whole thickness of the bladder-wall directly below the stalk of the tumor, but here, too, careful search failed to show the slightest evidence of epithelial infiltration in the submucosa or muscularis in any of them. Serial sections were not made.

CASE XXXVIII.—This specimen was a coarsely, papillary growth, about 2 cm. x3 cm., with a short stalk springing from the submucosa of the der-wall, containing large-sized blood-vessels. There was an intense inflammatory condition of both tumor and bladder-wall, evidenced by infiltra-

tion with leucocytes and necrosis. This considerably obscured the histology of the growth. The surface epithelium was mostly denuded; in one place only there were strips of a many-layered epithelium upon a connective-tissue stalk, forming a typical papillary process. The pedicle of the tumor, even close to its base, enclosed large masses of large variable-sized cells, some with several nuclei, which were regarded as atypical epithelial cells. There was no epithelial invasion of the bladder-wall itself.

CASE XXXIX.—The specimen was that of a villous tumor, 2x3 cm., the smaller of 2 similar growths, arising by a number of separate fine stalks from the submucosa of the bladder-wall. Viewed with a hand lens, the growth resembled a jungle of long grass. The long slender stalks, which showed but little branching, were covered with a comparatively narrow layer of cylindrical or spindle-shaped epithelial cells. Towards their ends the stalks were bare, the epithelium being stripped off and lying around loose, mostly at the bases of the stalks. Mitoses were rare. Many plasma cells were found in the connective-tissue stalks. There was no epithelial infiltration of the bladder-wall.

CASE XLI.—This specimen showed a delicate villous growth of small size, 1½x1½ cm., arising from the submucosa of the bladder-wall by a bunch of separate connective-tissue stalks. These stalks were long and slender, with but few branches, and were mostly stripped of epithelium, the epithelial cells lying loose in confused masses between the bases of the villi. These cells were cylindrical and spindle-shaped and varied considerably. There was absolutely no epithelial infiltration of the bladder wall. (Fig. 3.)

Summary.—A recapitulation of this analysis of the 11 cases regarded as papillomata may be stated as follows:

Four were demonstrated by complete histological examination of the base and bladder-wall to be benign. Cases XXX, XXXVIII, XXXIX, and XLI.

Three may be considered benign as far as a histological examination of a portion of the bladder-wall goes. Cases XXIX, XXXIII, XXXVII.

Of the 4 remaining cases which were histologically doubtful, one case (No. XXI) may be reasonably considered to have been benign in the light of the subsequent clinical history; probably also Case XX. One case (No. XXVI) which recurred in a malignant form may have been such from the start, though not necessarily. One case (No. XXXV) is still doubtful.

Number, Size, Situation, and Form.—In 7 of the 11 cases

of papillomata the tumors were single; in each of the other 4 cases there were 2 tumors. There were no cases in this series with large numbers of papillomata,—papillomatosis.

The situation was not always exactly stated. The favorite site seemed to be at the base of the bladder near the ureteral openings. Where 2 tumors existed, the larger one was usually at the base of the bladder and the smaller on the posterior wall, at a point which would be in contact with the other when the viscus was empty. This was quite striking in Cases XXX and XXXVII, and seems to corroborate the theory of propagation by contact, which Albarran states is an indisputable fact.

In size the papillomata varied from one which was described in situ as being somewhat smaller than a lemon, which was the largest, to one the size of a small pea, the smallest.

As to form, there were two excellent specimens of the villous papillomata in Cases XXXIX and XLI; 6 were of the commoner, lobulated, or cauliflower type (Nos. XX, XXI, XXVI, XXXV, and XXXVII). The 3 remaining cases represented intermediate forms.

Cases of Carcinoma.—The specimens in the 6 cases regarded as carcinoma while affording sufficient histological data for a diagnosis, were not sufficient either in number or completeness to allow of a differentiation of varieties.

One specimen was obtained at autopsy, the other 5 at operations. The latter were removed piecemeal, so that they were necessarily fragmentary and incomplete. Only one of them showed the muscularis of the bladder-wall. In the other 4 specimens the question of infiltration, as far as the microscope was concerned, remained undetermined. It has been stated that infiltration of the bladder-wall is the distinctive mark of a papillary carcinoma of the bladder, and such it is in differentiating it from a papilloma; but where the structure is not of a papillary nature the diagnosis can be adequately made from the type and arrangement of the epithelium and its relation to the connective tissue, without reference to the bladder-wall.

A brief description of these specimens follows:

CASE XXIV.[8]—A sessile, friable tumor with a base the diameter of a silver dollar was removed by morcellement from the floor of the bladder. Sections of the fragments showed on the surface a few connective-tissue processes covered with epithelium, which were suggestive of a papillary structure, and a loose, columnar arrangement of epithelial cells in the connective tissue of what was regarded as the submucosa.

CASE XXVII.—The projecting portions of a hard mass, involving the base and posterior wall of the bladder, were removed by morcellement. The specimen on section showed masses of large atypical epithelial cells invading a stroma of connective tissue. No mucosa or muscularis of bladder-wall could be recognized.

CASE XXXI.—A "papillomatous" tumor of large size was removed from the anterior wall and base of the bladder. A section of a fragment of the growth showed in places an arrangement of the epithelium and connective-tissue stroma suggesting villi which had become fused; in other places the arrangement was of an alveolar structure. The cells were very large and flat, of squamous type. No part of the bladder-wall could be recognized as such, in the section. There were many cell inclusions in this specimen.

Six months later a secondary operation showed the base of the bladder completely studded with hard nodules, with considerable induration of the bladder-wall. Section of one of these nodules which was curetted off, showed solid masses of epithelial cells of smaller size than in the preceding growth, separated by fine, fibrous trabeculæ.

CASE XXXII.—A portion only of a mass involving the right side of the bladder was removed. On section it showed solid masses of large epithelial cells infiltrating between the bundles of muscular fibres of the bladder-wall.

CASE XXXIV.—At operation the bladder was seen to be covered with "villous-looking nodules," which were easily separated from the bladder-wall. The latter was diffusely infiltrated and the urethral orifice was surrounded by a growth which was scraped off. Section of a fragment showed masses of small epithelial cells separated by a fine vascular connective-tissue stroma. No "villi" were to be seen, nor could any portion of the bladder-wall be identified.

CASE XL.—In this case the tumor was found at autopsy. An abstract of the report follows: In the bladder an irregularly ovoid, fairly smooth tumor, about 2¾ cm. in greatest diameter, with short pedicle, situated near the beginning of prostatic urethra, was found. The mucous membrane of the neck of the bladder and trigonum was generally beset with numerous small, whitish, nodules. The prostate was enlarged. Sections of the tumor showed groups and columns of atypical epithelial cells

[8] This case has been reported by Dr. F. B. Harrington. Boston Med. & Surg. Jour., May 29, 1902.

in places forming more or less perfect tubular structures, arranged in a dense, fibrous-tissue stroma. A section of the prostate showed increase in the interstitial connective tissue and dilatation of the tubules with atrophy of their epithelium, a few columns and masses of carcinomatous cells were present in the lymph-spaces. There were metastases in the retroperitoneal lymph-nodes. The growth was regarded as an adeno-carcinoma, primary in the bladder.

Summary.—These 6 cases of carcinoma may be summed up as follows:

In Case XL, an adeno-carcinoma, which is a rare form of primary cancer of the bladder, the possibility that the original focus of disease was in the prostate cannot be positively denied.

In Case XXXII, an alveolar carcinoma, infiltrating the bladder-wall, the diagnosis is unassailable.

In Case XXIV, there was fairly satisfactory evidence of infiltration of the submucosa of the bladder-wall.

In the other 3 cases, microscopic evidence of infiltration of the bladder-wall was lacking; there was, however, macroscopic evidence of it at the time of operation. In all of the specimens the histological structure of groups of atypical epithelial cells enclosed in a connective-tissue stroma was sufficiently convincing; 2 cases (Nos. XXIV and XXXI) showed slight evidences of villi in places, sufficient to suggest papillary carcinoma.

The after-histories of these cases gives further proof of their malignancy, if any were needed.

In Case XXIV death resulted 6 months after the operation, the disease having returned with great loss of blood.

In Cases XXVII, XXXI, XXXII, and XXXIV, death from the disease resulted in from 2 weeks to 6 months after operation. In no case was there an autopsy.

Malignant Degeneration of a Benign Papilloma.—There has been much discussion upon this important subject, the weight of authority seeming to favor the possibility of such a change. Civiale first advanced the view that a benign papilloma of the bladder, called at that period fungus, might take on a cancerous change. This view is shared by Küster, Thompson,

Orth, Von Antal, Ziegler, Albarran, Zuckerkandl and many others.

On the other hand, Rauschenbusch does not believe in this transition, and Lubarsch holds that it is not proven. Nitze, in his vast experience, has never observed a case in which a tumor of the bladder, removed at a second operation, showed a different structure from the original.

The subject being of much practical importance, it seems worth while to examine briefly the evidence.

In the first place, there is the analogy of authenticated cases of papilloma of the larynx becoming cancerous. This has been shown by Semon to be much rarer than was generally believed. He collected statistics of 10,774 cases of benign tumors of the larynx, in only 5 of which did he find the evidence of carcinomatous change incontrovertible. The scarcity of these cases is explained by Wendel on the ground that papilloma of the larynx, unlike papilloma of the bladder, occurs mostly at an age when there is but slight tendency to cancer.

Secondly, clinical evidence seems to support the theory, for how else are cases to be explained, of which a number have been reported by Fenwick and others, where there have been symptoms of painless hæmaturia for 20 years or more, and at operation papillary tumors have been removed, showing but limited epithelial infiltration of their bases? It does not seem reasonable to suppose that such cases could have been malignant from the start, when symptoms have been so mild and the progress of the lesion so slow.

Thirdly, there is a considerable accumulation of histological evidence by different observers. Orth states that he has observed a bladder in which near a large, unmistakably cancerous, papillary growth, smaller papillary tumors were present, in which nothing of a cancerous nature was to be found. A large number of similar observations are recorded in the literature.

Zuckerkandl recognizes two modes of cancerous transformation of a simple papilloma. In one he describes the pro-

cess as beginning in the tumor itself. In this form the epithelial cells in places lose their regular form and arrangement; they become packed together in dense masses, numerous mitoses attest their rapid growth, and as a result of this epithelial proliferation, the line of demarcation between epithelium and stroma becomes less sharp, and in places groups of epithelial cells will be seen breaking into the connective-tissue spaces. In more advanced stages the papillary processes become fused and unrecognizable, only a sparse stroma with blood-vessels remaining of the original framework.

In the second form, the tumor itself remains anatomically benign in appearance, while deep in the underlying bladder-wall small metastatic masses of epithelial cells attest the malignancy of the growth. This form is illustrated by a reproduction of an actual specimen of a villous papilloma of extremely benign appearance, the exquisite malignancy of which is, however, shown by the presence of a small epithelial thrombus in the midst of the muscular coat of the bladder-wall. The first form of transformation is also illustrated by specimens.

Noteworthy cases similar to these have been reported by Colley, Schuchardt, Wendel, and others.

There is only one case in this series which can properly be considered under this heading:

CASE XXVI.—After 3½ years of intermittent hæmaturia a papillary tumor was removed from the bladder by operation. This growth has already been described among the papillomata. (Figs. 6 and 7.)

There was a recurrence of symptoms and a second operation one year and six months later, with death from the disease two months after the second operation. At this second operation the bladder was found to be filled with large soft masses of cauliflower appearance, which were extirpated with cutting forceps. The largest of these masses removed was 3 cm. in diameter. The only specimen preserved showed on section 4 papillary stalks arising from a connective-tissue base. No portion of the bladder-wall could be identified. The connective-tissue stalks were comparatively narrow, quite vascular, branched freely, and were covered with a very thick layer of epithelial cells. These cells varied considerably in size, and were packed together without definite arrangement, so that in places adjoining villi appeared fused together, producing an appearance not unlike alveolar cancer. In other places the papillary structure

was quite regular. Mitoses were numerous. Everywhere the line of demarcation between epithelium and connective tissue was indistinct. The two tissues shaded insensibly into each other. Within a large blood-vessel of one of the stalks there was a group of epithelial cells; this was interpreted as an illusion, the result of the direction of the section, and not a real epithelial thrombus. Lying in the blood about the specimen both at the surface and at the edge of the connective-tissue base, there were small clumps of epithelial cells which were regarded as probably broken from the villi. There were, however, two clumps of epithelial cells which lay directly within the connective tissue of the base, not upon it, or at its edge, which could not but be regarded as evidence of infiltration. This fact, together with the macroscopic evidence of infiltration of the bladder-wall, makes it clear that the growth at the time of the second operation was a papillary carcinoma. (Fig. 8 and 9.)

This case is cited as a suggestive one; it cannot be claimed to be convincing, since the original specimen contained no bladder wall and therefore could not be proved to be benign.

SYMPTOMS AND COURSE OF THE DISEASE.

Hæmaturia is the cardinal symptom of tumor of the bladder; it is intermittent, at least at first, usually painless, except in malignant cases, unassociated with rest or motion, and unaffected by any therapeutic measure.

Of the 41 cases studied, hæmaturia was noted in 40, the only exception being Case XVIII, a myoma. In 20 cases it was the first symptom. In benign cases the bleeding may persist for years without other symptoms. The longest period noted among these cases was in No. V, in which case there had been intermittent hæmaturia for 16 years.

Sooner or later, however, a train of secondary symptoms is sure to arrive, due to infection of the urinary tract (cystitis, pyelitis, pyelo-nephritis, etc.,) or to mechanical blocking of the inflow or outflow of urine resulting in hydro or pyonephrosis or retention. The cases with symptoms of cystitis have already been enumerated. Retention was very common. Hydronephrosis was noted three times. Cases IV, XVII, and XXXVIII.

Incrustation of the tumor with urinary salts is a frequent occurrence and has already been fully considered. Necrosis

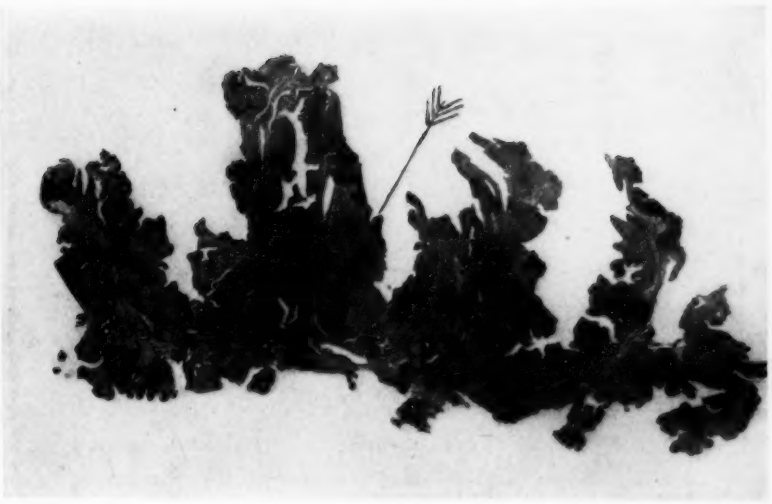

Fig. 8. Section of a fragment of recurrent papillary growth removed at second operation in (Case XXVI) x 5 diameters. No bladder wall is shown.

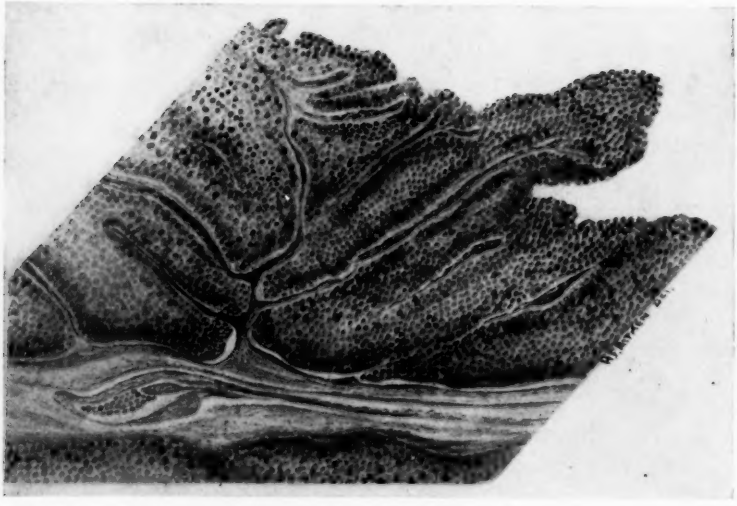

Fig. 9. Low-power drawing of detail of same at point marked by arrow in Fig. 8. The relative increase in epithelium, and the atypical character and arrangement of the cells, also the fusion of the villous processes contrasts markedly with Fig. 7.

and ulceration are more common in malignant cases. Perforation into the intestines or peritoneal cavity may even occur. It was not noted in any of these cases.

In general the course of a malignant tumor is much the same as in a benign, only more rapid. Cancer of the bladder, however, is considered to be of comparatively slow growth, setting up metastases late. There is usually more pain than in benign cases and, after ulceration has set in, the condition of the patient becomes truly pitiable.

DIAGNOSIS.

The value of cystoscopy in making the diagnosis of this condition cannot be overestimated. Data as to the size, situation, character, and number of growths, also as to the advisability of operation can be obtained by this means only.

The method is applicable to all cases with the 3 following exceptions: (1) where the urethra is impassable to the cystoscope; (2) where the hemorrhage is profuse and persistent; (3) where the growth on account of its size or position prevents the necessary manipulation of the instrument. The first obstacle can usually be overcome by appropriate methods of dilatation, the second by appropriate irrigation, or by the selection of a favorable opportunity, and the last is very unusual.

The method was employed in nearly all the recent cases in this series, and I think it might have been used with benefit in all of them. The time-honored methods of examination in all vesical diseases, such as examination of the urine, especially for villous fragments, rectal examination, etc., are also of value in making the diagnosis, and should not of course be neglected.

PROGNOSIS.

Albarran says "En clinique, ce qu'il faut dire, c'est que toute vesicale est maligne on peut le devenir."

Every tumor of the bladder unless removed will in time certainly lead to a fatal termination, either from hemorrhage, or as the result of the secondary changes already mentioned. Alleged cures by spontaneous extrusion of the growth through

the urethra have been reported, but are too rare to substantially affect the truth of the preceding statement.

The clinical malignancy of the anatomically benign bladder-tumors could not be better illustrated than in Cases XXXIX and XLI.

CASE XXXIX.—A laborer, 60 years of age, was brought to the accident department of the hospital, December 22, 1900, with a history of having passed blood with his urine for 6 months. Three weeks ago the hæmaturia became constant. One week ago he took to his bed and has failed rapidly since.

He was profoundly anæmic, and nearly moribund when brought to the hospital. In spite of irrigations of the bladder with various styptics, the bleeding continued, and he died on the third day after entrance.

Autopsy revealed, as the source of hemorrhage, two pedunculated tumors, the larger 4x5½x1½ cm., about 2 cm. apart, springing from the mucosa of the bladder-wall just above the left ureteral orifice. One of these specimens was preserved and has already been described. There was no evidence either macroscopical or microscopical of epithelial infiltration of the bladder-wall.

CASE XLI.—A man fifty-five years old, entered the medical department of the hospital June 1, 1901, with the following history: An attack of hæmaturia 1½ years ago; at this time there was some pain referred to the penis. One year later there was another severe attack. For the last three weeks he has been passing blood and clots constantly. Has had heart trouble for years.

The bleeding continued, uninfluenced by various internal remedies and he died June 7. At autopsy, atheromatous endocarditis of the mitral valves was found, and fibrous endocarditis of the tricuspid valve with hypertrophy and dilatation of the heart. The bladder contained much clotted blood and showed on its posterior wall a small villous papilloma which has already been described. (See Fig. 3.) Other organs were not remarkable.

The severity of the cardiac lesions in this case undoubtedly explains why surgery was not resorted to.

Fig. 3. Section of a villous papilloma x 6 diameters, anatomically benign, clinically malignant (Case XLI).

TREATMENT.

The only effective treatment of tumors of the bladder is operative removal. In malignant cases palliative measures may be advisable.

The treatment was operative in 37 of the cases here reported. In no case was an attempt made to radically remove an infiltrating cancer of the bladder-wall. Palliative measures, such as curettage, cauterization, and partial removal, were resorted to for symptomatic reasons in such cases.

Pedunculated tumors were removed with or without portions of the underlying bladder-wall, as the case might be.

Suprapubic cystotomy was done primarily in 28 cases, perineal cystotomy in 4, vaginal cystotomy in one; in 4 female cases the tumors were reached by dilatation of the urethra.

In 4 cases secondary suprapubic operations were done for recurrences. In one case the first operation at the hospital was for recurrence.

Results of Operation.—Of the 37 cases of all kinds, benign and malignant, favorable and unfavorable which came to operation, 9 resulted fatally within one month, or while still in the hospital, giving a mortality of slightly under 25 per cent. which can be ascribed to the operation.

Of the 28 patients who survived the operation and were discharged from the hospital, 26 have been traced; 14 (54 cent.) of these are known to have died of the disease; 12 of them died within 18 months of the operation.

In the 2 cases which survived a longer time, secondary operations were done for recurrent growths. In one of these cases, life was prolonged for 5 years after the first operation; 3 suprapubic cystotomies and several tappings of a hydronephrotic kidney having been done altogether. (Case XVII.)

Four patients (15 per cent.) have died of other diseases, without recurrence of the bladder-tumors, so far as could be learned.

In Case I, the cause of death was given as " renal calculi,"

13 years after the removal of a bladder-tumor, of which there was no microscopical report.

In Case V, cause of death was typhoid fever 9 years after the removal of a papillary epithelial growth.

In Case IX, pulmonary tuberculosis was the cause of death 3 years after the removal of a bladder-tumor, of which there was no microscopical report.

In Case XX "shock" (cerebral hemorrhage) was given as the cause of death, 1 year and 6 months after the removal of a papilloma.

Seven patients (27 per cent.) were living and well at the time this investigation was made; 2 of these (Nos. XXXVI, a case of fibro-myo-sarcoma, and XXXVII, a case of papilloma) are too recent to count. One patient (No. XIV), a case in which there was no microscopical report of the tumor, was well for ten years after the operation.

Four patients (Cases XXI, XXIX, XXXIII, and XXXV, in which the tumors were papillomata), are living and well, respectively, 8 years, 2 years, 1 year and ½ year after the operation.

One patient (No. XVIII), a case of myoma, was in good health 2 years after the operation, but has not been heard from during the last 8 years.

It is impossible to fix upon any definite postoperative period of immunity as establishing a cure. Therefore, the word will be avoided in summing up the favorable results, which may be stated as follows:

Twelve patients (46 per cent.), including those who died of other diseases, have had no recurrence so far as known; 9 of these are known to have survived the operation one year; 7 survived the operation two years; 5 survived the operation 8 years; 3 of these dying of other diseases, leaving 2 patients (Nos. XIV and XXI), still living and well, respectively 8 and 10 years after operation.

The end results of the cases in which the histological character of the growths was personally studied, have already been incidentally mentioned.

The 5 cases of carcinoma which were operated upon, all resulted fatally within 6 months of the operation. In none of these cases was the operation radical.

Of the 8 cases of papillomata which were operated upon, there was:

One (Case XXX) in which death was the direct result of the operation.

One (Case XX) in which death resulted 18 months after the operation from another disease without recurrence.

One (Case XXVI) in which recurrence in the form of carcinoma took place, with death 2 months after a second operation.

In the other 5 cases (XXI, XXIX, XXXIII, XXXV, and XXXVII) the patients are still living and well.

Recurrence.—The cases in which recurrence occurred have already been detailed. It is the rule in cases of carcinoma and sarcoma, and common in papilloma. It is doubtful if the word can be properly applied in all cases of subsequent growths of the latter type. There are numerous instances where papillomata reappear in the bladder after removal, not at their previous sites but in other parts of the bladder-wall. In such cases there seems to be a predisposition or tendency towards the formation of papillary growths, which naturally is not affected by the mere removal of any one growth.

As a rule, rapidly and repeatedly-recurring tumors are malignant in the end if not from the beginning. *Vide* Case XVII of Table. That every recurrent papillary growth is malignant is not true, as is shown by the following case:

Case XXI.—A man, aged 55 years, entered the hospital July 16, 1897, with the history that 7 years before he began to have more or less trouble in passing urine, with frequency at night.

There was a gradual onset of hæmaturia. Two years later he was operated on by Dr. Cabot in private, and a tumor was removed from the bladder by suprapubic cystotomy. He got along very well for three years after this, during which time it had been his custom to pass a catheter upon himself every other day. Then symptoms as before operation gradually returned. A suprapubic cystotomy was done by Dr. Cabot at the hospital. Two small pedunculated growths about the circumference of dimes were removed, and their bases cauterized. One of these was situated near the right ureteral orifice, the other to the right and behind the urethral orifice. The record stated that the latter was about on the site of the previous tumor.

The patient made an uneventful recovery and was seen by me on May 16, 1905, nearly 8 years after the second operation, when he reported his health to be excellent, without urinary symptoms of any kind. The urine was examined at this time and found to be normal in every way.

The two specimens in this case were alike. One of them has already been described. (See Figs. 4 and 5.)

CONCLUSIONS.

From this clinical and histological study of tumors of the bladder the following conclusions may be drawn:

1. Stone in the bladder is not an etiological factor of importance in the causation of these tumors.

2. The condition of the underlying bladder-wall in regard to epithelial infiltration, is the most satisfactory and reliable guide in the determination of the benign or malignant character of papillary epithelial tumors of the bladder.

3. If the foregoing condition is accepted as the differential test of these growths then will the benign forms commonly called papillomata, be found to at least equal if not outnumber the malignant, the papillary carcinomata.

4. Recurrent epithelial tumors are not necessarily malignant.

5. Papillary tumors of the bladder, proved to be histologically benign, may rapidly lead to a fatal result if let alone.

6. Surgical intervention at the proper time in the case of pedunculated papillary tumors of the bladder offers a very fair chance of long immunity, if not of permanent cure.

7. The method of surgical intervention to be preferred in these cases, is excision of the tumor in toto, with a margin of bladder-wall at its base, including mucosa, submucosa, and muscularis in part; the section need not penetrate the entire thickness of the wall. In this way, a beginning epithelial infiltration of the base if present, may be circumvented; or if it is not present, the knowledge of the fact is of great value in the important matters of diagnosis and prognosis. The defect in the bladder-wall should be closed with sutures, which will at the same time control hemorrhage. The gravity of the operation is not appreciably increased by this procedure.

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TABLE OF OPERATED CASES.

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
I S.T.E.	Aug. 4, 1877	45	F.	Frequent and painful micturition 2 years. Hæmaturia 2 mos. Two previous plastic operations on vagina	Dilatation of urethra. Digital removal of bladder tumor	Dr. J. C. Warren	Villous growth incrusted with urinary salts. No microscopical report	Operative recovery	Died 15 yrs. later of renal calculi. (Mass. Archives)
II M.R.	Nov. 1, 1883	53	M.	Hæmaturia 5 mos. Severe pain, pyuria, chills. Passed cauliflower-like pieces of tissue	Perineal cystotomy, villous growth removed with curette	Dr. C. B. Porter	Fragments of growth passed in urine examined and reported as villous cancer. No microscopical report of tumor itself	Operative recovery Discharged with perineal fistula	Died 3 mos. later of cancer of bladder
III W.S.P.	Jan. 8, 1885	42	M.	Painful and frequent micturition. Little blood at the end of urination for 4 weeks	Perineal cystotomy, fungus growth removed with curette	Dr. C. B. Porter	Large rough tumor. No microscopical report	Died 9 days after operation. *Autopsy*, cancer of bladder wall with sloughing. Interstitial nephritis	
IV F.G.	Dec. 21, 1885	73	F.	First noticed urine was thick and brown 8 mos. ago; 2 mos. ago hæmaturia began accompanied by pain and frequency	Vaginal cystotomy, tumor the size of two English walnuts attached to post part of floor of bladder removed with curette	Dr. A. T. Cabot	Epithelial tumor incrusted with urinary salts (W. F. W.)	Died 7 days after operation. *Autopsy*, gangrenous cystitis, hydronephrosis and pyelitis	
V L.J.D.	Sep. 27, 1886	34	M.	Intermittent hæmaturia for 16 yrs. Blood has been constant for past few mos., occasional pain, retention twice	Supra pubic cystotomy, white cretaceous growth scraped from bladder with curette	Dr. C. B. Porter	Exam. of fragments passed in urine after sounding showed the growth to be of a papillary epithelial nature. No microscopical report of the tumor itself	Operative recovery	Died 9 yrs. later of typhoid fever. (Mass. Archives)
VI J.J.R.	Sep. 28. 1887	59	M.	Intermittent hæmaturia for 16 mos. Pain in lower abdomen	Supra pubic cystotomy, sessile tumor removed, base cauterized.	Dr. M. H. Richardson	No microscopical report	Died in 6 days. *Autopsy* showed diphtheritic cystitis and cellulitis	
VII J.C.	April 19, 1889	52	M.	No venereal history. Symptoms of cystitis for 9 mos., blood in urinary sediment	Supra pubic cystotomy, bladder tumor curetted out	Dr. J. Homans	Friable new growth largely filling bladder. Microscopical report, *Epithelioma* (W. F. W.)	Died in 7 days. No autopsy	

VIII A.W.	Nov. 19, 1889	50	M.	No venereal history. Dull pain in loin, intermittent hæmaturia beginning 10 months ago following a fall, occasional retention from clots. Hæmaturia constant for 4 wks.	Supra pubic cystotomy, small tumor near rt. ureteral orifice curetted out	Dr. C. B. Porter	No microscopical report	Operative recovery	Died of carcinoma of bladder 1 yr. and 5 mos. after operation
IX M.M.	Jan. 9, 1890	29	F.	Symptoms of cystitis following confinement 9 mos. previous. Hæmaturia for 8 mos.	Dilatation of urethra, tumor size of walnut at base of bladder curetted out	Dr. J. W. Elliot	No microscopical report	Operative recovery	Died 13 yrs. later of tuberculosis of lungs (Mass. Archives)
X A.E.S.	Jan. 14, 1892	51	F.	For 2 years has had urethral discharge, at times blood stained; 5 wks. ago portion of growth removed from urethra. Symptoms, frequency, pain and tenesmus	Growth involving urethra and ant. wall of vagina curetted, urethra dilated and papillomatous tumor of bladder curetted out	Dr. C. B. Porter	Microscopical report, *Infiltrating cancer* (W. F. W.)	Operative recovery	Died 8 mos. later of cancer of bladder
XI S.C.W.	Jan. 18, 1892	55	M.	No venereal; 20 yrs. ago had slight trouble in passing water for a few mos., no further trouble until 1 yr. ago when he first noticed clots of blood in urine. Intermittent hæmaturia since. Retention from clots	Perineal cystotomy, large papillomatous tumor attached to base of bladder removed with stone forceps	Dr. A. T. Cabot	No microscopical report	Operative recovery Developed insanity during convalescence	Died 1 yr. later with recurrence
XII E.S.	May 13, 1892	65	M.	Hæmaturia for 5 mos. Pain and frequency followed. Lost 50 lbs. in weight	Perineal cystotomy, tumor size of walnut curetted off bladder wall	Dr. J. Homans	No microscopical report	Operative recovery	Further history unknown
XIII J.G.	July 12, 1892	54	M.	Gonorrhœa 35 yrs. ago. Symptoms of cystitis began 8 wks. ago, 6 weeks ago began to pass blood.	Supra pubic cystotomy, tumor removed with curette, tumor was size of baby's hand above the ureteral orifice	Dr. A. T. Cabot	Microscopical report, *Cancer* (W. F. W.)	Operative recovery	Died 3 mos. later with recurrence
XIV J.H.	July 10, 1894	34	M.	Gonorrhœa 15 yrs. ago. Hæmaturia began 2 mos. ago following a fall. Constant bearing down pain	Supra pubic cystotomy, hard and dense tumor 2 in. by 1½ in., on floor of bladder removed with chain écraseur	Dr. S. J. Mixter	No microscopical report	Operative recovery	In perfect health Feb., 1905. Personally examined
XV J.E.B.	July 19, 1894	46	M.	In 1870 lateral perineal lithotomy. Frequency of micturition ever since. In 1889 supra pubic cystotomy by Dr. Cabot at M. G. H. "Pachydermia vesicae." Re-enters hospital with a broken-down supra pubic sinus and symptoms of severe cystitis with hæmaturia	Supra pubic sinus dilated, bladder explored, portion of a new growth removed with forceps	Dr. A. T. Cabot	Microscopical report, *Epidermoid cancer* (W. F. W.)	Gradually failed and died 1 month after operation. Autopsy showed cancer involving bladder wall, abdominal wall and retro-peritoneal glands	

TABLE OF OPERATED CASES—*Continuea.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
XVI G.C.F.	Dec. 22, 1894	61	M.	No venereal. Frequency for 7 mos. Hæmaturia 8 wks. Occasional stoppage. Pain for last 2 wks.	Supra pubic cystotomy, growth curetted from int. urethral orifice	Dr. C. B. Porter	Fragments obtained by washing bladder reported as papilloma. Microscopical report of masses removed at operation, *Cancer*, (W. F. W.)	Died 2 weeks later. No autopsy	
XVII * S.H.T.	Jan. 9, 1895	53	M.	No venereal. Frequency of micturition with scalding began 6 yrs. ago. Hæmaturia 1 year ago	No. 1—Supra pubic cystotomy, tumor size of Mandarin orange removed piecemeal from post. wall	Dr. S. J. Mixter	No microscopical report	Operative recovery	The hydronephrotic kidney refilled and was tapped several times subsequently. In March 1901, sound could not be made to enter bladder, which seemed filled with new growth. Patient died of the disease a few mos. later
	Re-entry, April 30, 1896			Relieved by operation for 1 yr. then hæmaturia recurred	No. 2—Supra pubic cystotomy, tumor size of orange on ant. wall removed with scissors and base cauterized	"	Microscopical report, cancer with slight infiltration of bladder wall (W. F. W.)	Operative recovery	
	Re-entry, June 23, 1897			Pain and hæmaturia recurred in 6 mos.	No. 3—Supra pubic cystotomy, papillomatous growth size of plum projecting from lower post. wall of bladder removed with curette		Microscopical report, Papillary cancer (W. F. W.)	Operative recovery	
	Re-entry, April 24, 1900			Pain and pressure in left side	No. 4—Cystic tumor in left hypochondrum tapped, 3 cvii brownish fluid evacuated	"	.....	Temporary relief	
XVIII M.V.B.M.	Nov. 12, 1895	57	M.	Stricture of urethra 15 yrs. ago; 9 yrs. ago renal colic, later passed some small stones, 1 yr. ago symptoms of cystitis began. In Feb., '95, litholapaxy at M. G. H. and again in August by Dr. Cabot in private. In Sept. a stone was washed out of bladder. In Nov. same symptoms recurred and he re-entered hospital	Supra pubic cystotomy, stone removed from post. prostatic pouch, two small hard projections incrusted with urinary salts removed from bladder wall	Dr. A. T. Cabot	Microscopical report, Myoma (W. F. W.)	Operative recovery	In good health 2 years after operation. Not heard from since

* This case has been reported by Dr. Mixter. Boston Medical and Surgical Journal, April 20, 1899.

XIX C.S.	Feb. 22, 1896	70	M.	No venereal. Pain and frequency 2 yrs, hæmaturia 8 months	Supra pubic cystotomy, large sessile tumor on right side of bladder curetted out	Dr. A. T. Cabot	Microscopical report, Flatcell cancer (W. F. W.)	Died in hospital 4 mos. later. Incomplete autopsy showed bladder extensively involved in growth	
XX S.B.	June 28, 1897	52	M.	Gonorrhœa 30 yrs. ago. Painless hæmaturia began 1½ yrs. ago. Later pain in left testicle and kidney	Supra pubic cystotomy, growth size of strawberry on post. wall above trigonum removed, base curetted	Dr. S. J. Mixter	Microscopical report, Papilloma. Impossible to say whether malignant or not (J. H. W.)	Operative recovery	Died 1 year and 6 months later of shock (cerebral hemorrhage) without recurrence of bladder symptoms
XXI E.S.	July 16, 1897	55	M.	No venereal; 7 years ago symptoms of frequency and afterwards hæmaturia began; 5 yrs. ago papilloma removed from bladder by Dr. A. T. Cabot in private; 2 yrs. ago symptoms recurred as before	Supra pubic cystotomy. two small tumors removed with forceps and their bases cauterized, one was situated to the outer side of the rt. ureteral orifice, the other behind uretral orifice about on the site of the previous tumor	Dr. A. T. Cabot	Microscopical report, *Papilloma*. Impossible to say whether or not malignant (J. H. W.)	Operative recovery	Personally examined in May, 1905, nearly 8 yrs. after second operation. Health perfect
XXII H.A.T.	Sep. 26, 1899	63	M.	No venereal. Frequency and hæmaturia for 6 mos. Occasional retention	Supra pubic cystotomy, growth on rt. side of bladder extending toward prostate curetted out, base cauterized	Dr. J. C. Warren	Microscopical report, *Cancer* (W. F. W.).	Operative recovery	Died 2 mos. later of recurrence
XXIII N.K.	May 13, 1900	26	F.	Symptoms of cystitis with hæmaturia for 2 yrs. following confinement. Passed several stones	No. 1—Dilatation of urethra, two small tumors, one on post. wall, one on left side, removed, bases curetted	Dr. J. W. Elliot	No microscopical report	Operative recovery	
	Re-entry, Dec. 1, 1900			Painful and bloody urination, returned soon after leaving hospital.	No. 2—Supra pubic cystotomy, deposit of calcareous matter on bladder wall curetted off, two small papillomatous masses removed	Dr. R. B. Greenough	No microscopical report	Operative recovery	Subsequent history unknown
XXIV J.P.K.	Aug. 20, 1900	49	M.	Hæmaturia began 10 wks. ago. Pain and frequency began soon after	Supra pubic cystotomy, sessile friable tumor with base size of silver dollar removed from base of bladder with prostatome	Dr. F. B. Harrington	Microscopical report, *Villous Carcinoma* (J. H. W.)	Operative recovery	Died in another hospital with recurrence 1 yr. and 6 mos. later
XXV L.V.	Oct. 29, 1900	69	M.	No venereal. Pain, frequency and hæmaturia began about 6 mos. ago	Supra pubic cystotomy, a soft sloughing pedunculated tumor at neck of bladder removed with curette	Dr. J. C. Warren	No microscopical report	Operative recovery	Died 3 mos. later of cancer of bladder

TABLE OF OPERATED CASES—*Continued.*

Case and Reference.	Date.	Age.	Sex.	Clinical Notes.	Operation.	Operator.	Nature of Tumor.	Immediate Result.	Ultimate Result.
XXVI F.H.D.	Dec. 31, 1900	58	M.	Gonorrhœa 38 yrs. ago. Hæmaturia began 1 yr. and 3 mos. ago. Intermittent since. Frequency during last month ; 3 attacks of retention	Supra pubic cystotomy, soft papillary mass on left side of bladder removed with forceps, base cauterized	Dr. A. T. Cabot	Microscopical report, *Papillary cancer* (W. F. W.)	Operative recovery	
	Re-entry, July 2, 1902			Blood re-appeared in urine 6 months after operation and continued with frequency and and tenesmus	Supra pubic cystotomy, bladder filled with large soft cauliflower mass which was removed piecemeal with forceps	"	Microscopical report, *Papilloma* (C. C. S.).	Discharged from hospital with permanent bladder drainage	Died 2 mos. later of the disease
XXVII F.L.	June 6, 1901	53	F.	Frequency 10 mos. Hæmaturia 8 mos. Pain	Supra pubic cystotomy, hard irregular mass involving base and post. wall of bladder, projecting portions of growth removed, curetted and cauterized	Dr. F. B. Harrington	Microscopical report, *Mesothelial cancer* (W. F. W.)	Operative recovery	Died 6 mos. later of the disease
XXVIII S.S.	Mar. 11, 1903	58	M.	No venereal. Hæmaturia 10 mos. Pain in left back. Frequency of micturition for 6 months	Supra pubic cystotomy, a mass projecting into the right side of the bladder removed with prostatic forceps, the growth also extended into pelvis, no attempt was made to remove it	Dr. A. T. Cabot	Microscopical report, *Round cell sarcoma* (W. F. W.)	Discharged from hospital with permanent supra pubic drainage	Died 2 mos. later of the disease
XXIX T.A.B.	Mar. 17, 1903	59	M.	No venereal. Hæmaturia 3 months.	Supra pubic cystotomy, papillomatous growth to the left of prostate removed with a margin of normal mucus membrane with cautery	Dr. A. T. Cabot	Tumor size of end of finger incrusted with urinary salts. Microscopical report, Malignant Papilloma. No evidence of infiltration of bladder wall (W. F. W.)	Operative recovery	Letter of May, 1905, reports perfect health. No urinary symptoms of any kind
XXX W.H.	July 8, 1903	57	M.	No venereal. Intermittent hæmaturia for 4 yrs. Slight pain and frequency	Supra pubic cystotomy, papillomatous tumor size of egg removed from ant. wall on left, bladder wall sutured, 3d lobe of prostate found enlarged and removed with prostatome	Dr. W. M. Conant	Microscopical report, *Papilloma, probably malignant* (C. C. S.) Adenoma of prostate.	Died in 24 hours. *Autopsy* showed hemorrhage into bladder; on post. wall of bladder small papilloma found; examination of bladder wall showed no epithelial infiltration	

XXXI N.W.	Jan. 31, 1904	40	M.	Operated on for stone in the bladder at the age of 9. No further urinary symptoms until hæmaturia began 2½ yrs. ago. Intermittent since	No. 1—Supra pubic cystotomy, papillomatous tumor at base of ant. wall of bladder removed with prostatic forceps	Dr. A. T. Cabot	Microscopical report, *Epithelioma* (W. F. W.)	Operative recovery	
	Re-entry, Aug. 1, 1904			After leaving hospital improved at first, then old symptoms returned	No. 2—Supra pubic cystotomy, base of bladder studded with hard nodules, considerable induration of bladder wall, nodules removed with curette and cautery	Dr. W. M. Conant	Microscopical report, *Carcinoma* (C.C.S.).	Operative recovery	Died of the disease 2 mos. later
XXXII E.B.	Mar. 14, 1904	58	M.	No venereal; 1 yr. ago passed gravel, 6 weeks ago retention; 3 weeks ago pain and bleeding began	Supra pubic cystotomy, mass involving left side of bladder, portion of growth removed	Dr. M.H. Richardson	Microscopical report, cancer	Operative recovery	Died 3 mos. later of the disease
XXXIII S.S.R.	May 10, 1904	63	F.	Intermittent painless hæmaturia for 2½ yrs.	Supra pubic cystotomy, pedunculated papillary growth size of lemon on post. wall of bladder excised at base, defect in bladder wall sutured	Dr. J. W. Elliot	Growth 6 cm. diam., pedicle 1 cm. Microscopical report, *Malignant papilloma*. No evidence of infiltration of bladder wall. (W. F. W.)	Operative recovery	Letter of May, 1905, reports perfect health. No urinary symptoms
XXXIV E.B.	June 2, 1904	57	M.	Frequency 8 mos. Pain in back and hæmaturia 1 mo. Retention	Supra pubic cystotomy, bladder mm. covered with villous nodules, urethral orifice surrounded by a growth which was scraped off	Dr. S. J. Mixter	Nodular fragments from the bladder, the wall of which was diffusely infiltrated with a new growth. Microscopical exam., *Cancer* (W. F. W.)	Died in 2 weeks; septic absorption. No autopsy	
XXXV A.M.	Dec. 20, 1904	58	M.	No venereal. Hæmaturia began 2 yrs. ago with constant dull pain in flank. Frequency occurred later	Supra pubic cystotomy, pedunculated tumor size of strawberry just above rt. ureteral orifice removed with scissors, with small margin of mucous membrane, site of tumor cauterized	Dr. L. Davis	Coarsely papillary tumor size of horse chestnut. Microscopical exam., *Malignant papilloma* (W. F. W.)	Operative recovery	Supra pubic prostatectomy Feb. 17, 1906. No recurrence
XXXVI M.S.	April 27, 1905	16	M.	19 mos. ago hæmaturia began accompanied by great pain. Frequency of micturition later developed with nocturnal incontinence	Supra pubic cystotomy, a firm tumor size of orange arising by a thick short pedicle from the right side of internal meatus removed en morcellement, leaving a thick, ragged base which was cauterized, lower portion of tumor was incrusted with urinary salts	Dr. F. G. Balch	Microscopical report, *Fibro-myo-sarcoma* (W. F. W.)	Operative recovery Discharged July 2 with small supra pubic fistula	Case too recent for data
XXXVII M.J.C.	Sep. 16, 1905	51	M.	Gonorrhœa many years ago; 2 years ago began to pass bloody urine without pain; 2 wks. ago retention	Supra pubic cystotomy, larger tumor removed from right edge of trigonum with scissors, site of tumor cauterized, smaller one on post. wall of bladder removed with a good margin, defect in bladder wall sutured	Dr. J. G. Mumford	Microscopical report, *Malignant papilloma* (W. F. W.)	Operative recovery Discharged from hospital Nov. 4, 1905, with granulating wound above pubes	Case too recent for data

TABLE OF UNOPERATED CASES OF TUMOR OF THE BLADDER FOUND AT AUTOPSY.

No.	Date	Age	Sex	Clinical Notes	Post-mortem Findings
XXXVIII Autopsy 87	April 15, 1897	70	Male	No venereal. Two years ago passed gravel. Five months ago began to have frequency of micturition. Hæmaturia began one month later and has been constant since, with much pain. Operation was deemed inadvisable on account of poor general condition. Patient slowly failed and died April 23, 1897.	"Papilloma of Bladder. Diphtheritic cystitis. Inflammatory infiltration of peri-vesical tissues. Sl. pyelo-nephrosis of left kidney. Sl. hydronephrosis of right kidney. Acute peritonitis. Acute degeneration of kidney. Infarction of kidney. Arterio-sclerosis with cardiac hypertrophy and dilatation. Emphysema. Hypostatic congestion and œdema of lungs."
XXXIX Autopsy 641	Dec. 22, 1900	60	Male	Brought to accident room in extremely weak and anæmic condition with history of having passed bloody urine for 6 months. Failed rapidly during last 3 weeks. In spite of washing the bladder with various styptic solutions, the hemorrhage continued and the patient died in 3 days.	"Papillomata of the bladder. Hemorrhage into bladder. General anæmia. Fatty degeneration of heart muscle. Concentric hypertrophy and dilatation of heart. Arterio-sclerosis of aorta and coronary arteries. Chronic atheromatous endocarditis of mitral valve with acute vegetations. Œdema of lungs. Cholelithiasis. Hyperplasia of spleen. Cysts of right kidney. Right hydrocele."
XL Autopsy 681	Feb. 25, 1901	64	Male	No venereal. Severe attacks of pain in region of left kidney for 20 years. Hæmaturia during last 2 months. An exploratory nephrotomy was done with negative result, and the bladder searched for stone without result. Patient died 4 days later with partial suppression of urine.	"Nephrotomy with hemorrhage into peri-nephric and retroperitoneal tissues. Adenocarcinoma of the neck of the bladder with metastasis in the retroperitoneal lymphatic glands. Senile degeneration of the kidneys. Adenoma of the prostate. Chronic interstitial prostatitis. Chronic pericholecystitis and perihepatitis. Œdema of lungs. Ecchymoses in the mucous membrane of the stomach. Defective closure of the foramen ovale of heart."
XLI Autopsy 710	June 8, 1901	55	Male	Heart trouble since childhood. Painless hæmaturia began 1½ years ago. For 3 weeks the bleeding was constant. Bleeding continued while in the hospital, with death at the end of a week. (Operation not undertaken presumably on account of heart.)	"Papilloma of Bladder with hemorrhage. General anæmia. Atheromatous endocarditis of the mitral and aortic valves. Fibrous endocarditis of the tricuspid valve. Hypertrophy and dilatation of the heart. Concretions in the prostate."

ISCHEMIC MUSCULAR ATROPHY, CONTRACTURES AND PARALYSIS.*

BY ALEXANDER HUGH FERGUSON, M.D., C.M.,

OF CHICAGO, ILL.,

Professor of Clinical Surgery in the University of Illinois.

ISCHEMIC atrophy and paralysis, being the changes which occur in muscles from which the blood-supply is more or less cut off, may be due to the following causes:

I. *Arterial*—depending on two causes: (*a*) Interruption must be nearly complete; (*b*) interruption must be of more than two of three hours' duration, otherwise it is easily tolerated—sometimes incomplete interruption for several days.

II. *An interrupted venous return.*—Causes: 1. Embolus—cardiac; 2. Thrombus—syphilitic endarteritis, or following acute infectious diseases; 3. Raynaud's disease—changes in vessels due to defective nerve innervation; 4. Direct injury to a vessel; 5. Cold; 6. Most common of all—tight splinting, to which I shall mostly refer.

Symptoms.—Paresthesia—numbness and tingling in parts of limb affected, and perhaps combined with alternating sensations. Severe and often paroxysmal pain in muscles followed by cramps and spasmodic jerkings. Limb often pale, but sometimes cyanosed and cold. Electric irritability of muscle lost after ischemic condition has lasted five hours, and the muscles are quite flaccid and powerless, as seen in operations after prolonged use of Esmarch's bandage. After seven hours, muscular rigidity and painful contractures begin. These increase in severity, but disappear in two or three days, leaving muscle again flaccid. Œdematous condition from more or less established collateral circulation. Muscles now tender on press-

* Read before the Chicago Surgical Society, December 1, 1905.

ure. Swelling gradually disappears; muscular atrophy becomes manifest, muscles being hard and firm.

Contractures follow—hand flexed at wrist, and fingers at phalangeal joint. Final contractures due to atrophy of muscles and overgrowth of fibrous connective tissue. Atrophic changes in the skin often present.

Course.—This depends on the duration of the primary ischemic condition. When cramps and rigidity have set in, probably no immediate recovery of the muscle is to be looked for, but short of this the muscles may readily recover, if the blood supply is restored. In cases where cramps have appeared, it is probable that many of the muscular fibres die, and have to be replaced by regeneration—a long and slow process, or by repair. When ischemia is of greater duration, and the muscles have become flaccid, it is not probable that any great amount of restitution can occur. However, certain fibres may have escaped, and from these new fibres may be formed, but the amount of recovery will be small. In such cases the muscles rapidly atrophy, becoming tough, hard and contracted.

Pathological Anatomy.—A. If blood supply is completely interrupted. B. If blood supply is partly interrupted.

A.—1. Muscle is gray, dirty yellow color, dull in appearance, and friable.

2. Under microscope—transverse and longitudinal structures more obvious.

3. Almost complete absence of muscular nuclei.

4. Usually no fatty degeneration.

B.—1. Muscle firm and tough; more or less normal in appearance.

2. Under microscope—great increase of fibrous connective tissue between bundles of muscular tissue and between individual muscle, fibres and cells.

3. Fibres have lost their polygonal form; are smaller and rounder, but maintain their striæ even under extreme atrophy.

II. *Interrupted Venous Return.*—1. Acute symptoms are

those of thrombus, viz., swelling, cyanosis, œdema; limb feels fuller, harder, and is tender on pressure.

2. Acute symptoms may pass off, but limb is left in condition of passive congestion, making limb larger—pseudo-hypertrophy.

Pathological Anatomy.—1. Early stage—increase of intermuscular fibrous connective tissue.

2. Later stage—connective tissue more abundant; some atrophy of muscles, fibres and fatty degeneration.[1]

Pressure Lesions of Nerves.—1. The resultant symptoms of severe cases of this are similar to nerve section and are paralytic in nature, pain and hyperæsthesia being usually absent.

2. Paralysis usually more marked than anæsthesia.

3. Trophic changes are usually rare.[2]

Having now made a brief, and, I trust, concise review of the most prominent points relating to ischemia, I desire to add a short account of two recent cases of this nature, on account of their aptitude to the subject, and the surprisingly favorable results attending my operative treatment of them.

CASE I.—On the 4th day of May, 1902, a school-boy, aged nine years, and weighing 65 pounds, entered Chicago Hospital, with the following trouble:

(*a*) Deformity of hand. The forearm, wrist and hand were crippled, and abnormal in size, shape and color. The whole extremity below the elbow was apparently much smaller than normal, and the fingers, which looked blue and felt cold, were flexed into the palm.

(*b*) Fixation. The fingers were not merely flexed into the palm, as already stated, but also there fixed. No effort on his part, nor considerable force by me, could effect but the slightest

[1] Chiefly indebted for this data to F. E. Batten, M.D., F.R.C.P., London.

[2] Chiefly from an article by W. Thorburn, M.D., and R. T. Williamson, Manchester, England.

increased flexion or extension. Voluntary motion at the wrist, or supination, or pronation, was extremely limited. (Fig. 1.)

(*c*) Atrophy. The bellies of the muscles appeared to be entirely absent, except near the elbow. The skin hugged the bones; the deeper soft parts were firm, hard and immovable. The circumference of the forearm was less than that of its fellow by about one-third.

(*d*) Paralysis. The hand was paralyzed as to motion, although the muscles responded to irritation and electricity near the elbow at the points where they were applied. When electricity was applied to the extensor muscles of the hand, no extension ensued of either wrist or fingers. Sensation of the fingers and hand was rather increased. Sensations of heat and cold were normal.

(*e*) Loss of function. The hand was useless for ordinary purposes.

Although an anteoperative photograph was not successfully obtained, yet I endeavored to make good this interesting deficiency by having a postoperative picture taken of the arm placed in its original malposition. This is shown in Fig. 1.

History.—Four years previously the patient had both bones of right forearm broken at the middle, which, when set, was put up with fingers flexed and bandages tight. When the splints were removed, seven weeks afterwards, and the condition of the limb discovered, he was brought to an eminent Chicago surgeon, who stretched the fingers, giving some improvement, but no cure.

Operation.—An Esmarch bandage was applied in proper manner for the case. A long curved incision was made on flexor surface of forearm. All the muscles and tendons were found matted together by fibrous tissue. These were separated from each other, and the ulnar and median nerves were disengaged and stretched. Muscle-tendon splicing was done on all the flexors, in order that the lengthened tendons would permit of the extension of the fingers. The cavity of the wound was filled with sterilized olive oil around the tendons and nerves. Capillary drainage inserted; wound closed, and hand placed in hyper-extended position; held there by splints.

The operation consumed an hour and five minutes, under chloroform. The patient behaved well and reacted properly.

FIG. 1.—Deformity in Case No. 1. Since I failed to secure a good photograph of the arm previous to operation, and not wishing to be without a picture of the arm in its pre-operative position, I had it again taken after the operation in its original mal-position. This figure shows it quite well.

Upon exposing the muscles and tendons their small size was very obvious. In carrying out their isolation some difficulty was experienced in identifying one tendon from the adjacent one. The knife was constantly in use. Cleavage was impossible in the middle of the forearm, for here all semblance of tendon sheaths was gone. The tendons appeared longer than normal, and seemed to encroach upon the muscle substance. On account of the pressure atrophy the muscles were small, firm and fibrous to a marked degree. The musculo-tendon splicing being completed, the hand and fingers placed in a hyper-extended position, I could not but remark upon the long and insignificant-looking threads, and express a very doubtful prognosis. The return of arterial blood into the parts after removing the rubber bandage did not clear away the paleness of the structures, nor my apprehension of their viability. The olive oil was used to prevent, if possible, an immediate gluing together of all the tendons again, and I feel sure of its benefit in this case, to the end desired. The median and ulnar nerves were here and there nodular, and in some places smaller than normal.

Postoperative.—On the third day he developed a temperature which on the evening of the fourth day reached 104.4° F. The wound was dressed and found all right. On the fifth day the temperature was down, but again rose rapidly. He had tympany and extreme tenderness in right iliac and hypogastric regions; leucocytes 30,000; also some diarrhœa. The area was again dressed and found in perfect order. He was then operated upon for appendicitis (acute obstructive variety), and that member was found inflamed, enlarged and obstructed. After operation, pain abated and temperature was lower for a few days, but on the fourth day following this last operation pyrexia and its concomitant symptoms returned, and continued more or less for two weeks. but not alarming. Widal reaction and diazo-reaction tests were both negative, and no abdominal spots appeared, although there were diarrhœa and tympanites. Liquid diet was substituted, and quinine sulphate, gr. iii, every four hours, and hydrargyrum cum creta, gr. ii, every night, administered. By the twenty-third day the patient was sufficiently recovered to return to his home. During his stay in the hospital his arm was dressed frequently and under passive motion slowly improved. The wound healed by

first intention. The fingers could then be easily straightened passively, and almost to a complete degree voluntarily. He could hold his fingers completely shut passively and had considerable flexor power. See Figs. 2, 3, and 4.

The following is the last report (November 28, 1905): "He can straighten the fingers and can close them slightly only. He can hold the hand shut by using the thumb after he has shut it with the other hand. He uses the hand to write and do his school-work, but we do not think he has got as much use of it as you expected; still we think it is gaining all the time." (Figs. 6 and 7.)

CASE II.—Mary H., aged 12 years, weight 80 pounds. Entered Chicago Hospital, November 5, 1904, with the following history, in part, viz.: Ten weeks previously the left humerus was fractured at the junction of the lower and middle thirds. The fragments were soon placed in apposition, and tight splints were bandaged on the entire arm and forearm, and left in this position for seven weeks.

Examination revealed a scar, one-half inch wide and three inches long, extending from the front around to the posterior surface of the arm, three inches above the left elbow joint (Fig. 7). The elbow joint was stiff and tender, and even moderate flexion was impossible. There was a deformity at the wrist and hand, consisting of marked flexion. The proximal phalanges were fully extended, and the two distal segments of the phalanges completely flexed. The forearm showed great atrophy, this being more marked in the region of the flexor bellies. She was unable of herself to adjust this malposition, and any attempt to correct it by forcible manipulation was not only painful, but entirely devoid of even temporary improvement, giving marked evidence of the matting together of the structures of the forearm. Sensations of heat and cold, muscular sense, and tactile sense were lost, except in the index and little fingers, and here they were imperfect and slow.

The hand was colder than its fellow, in all probability showing vasomotor interference.

Operation.—Having applied an Esmarch bandage, an incision was made along the inner border of the biceps for the purpose of exposing the seat of fracture of the humerus and liberating any

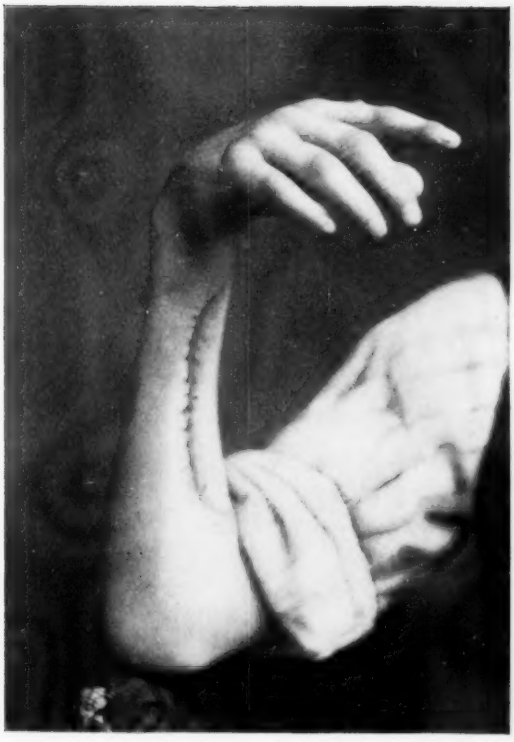

FIG. 2.—Showing the extreme limit of voluntary flexion of wrist after operation in case 1.

FIG. 3.—Showing limit of voluntary extension of fingers after operation in case 1.

FIG. 4.—Showing limit of voluntary flexion of fingers after operation in case 1.

FIG. 5.—Case 1, November 28, 1905. Extension over three years after operation.

FIG. 6.—Case 1, November 28, 1905. Flexion over three years after operation.

FIG. 7.—Arm before operation in case 2. 1, Transverse scar three inches long running half way around the arm three inches above elbow joint; 2, Atrophy of flexor bellies; 3, Flexion and fixation of wrist; 4, Extension and fixation of proximal phalanges; 5, Acute flexion and fixation of two distal segments of phalanges.

osseous or connective-tissue adhesions which might have formed around the ulnar or median nerves and at the same time determine what damage, if any, had been done to those latter structures. On exposing these nerves, they were found to be normal in appearance, and the bone well united. A second incision was made along the outer surface of the arm, exposing the musculo-spiral nerve, which was thickened and bulbous. These incisions having been closed, the first incision was continued down the forearm and well into the palm. The flexor tendons, having been identified, were individually treated in the following manner: A longitudinal incision, four or five inches long, was made in each muscle and its tendon, cutting across one-half of the tendon from its continuity below, and then transversely severing the muscular portion of the other half above. These corresponding musculo-tendon halves were then temporarily united with fine catgut to maintain their identity. A similar procedure was followed on all the other flexors of the wrist and hand. They were then securely sutured in the extended position by means of three interrupted sutures in each musculo-tendinous structure. Although the wrist and hand were thus liberated, full extension was not possible until the nerves were separated from their surrounding adhesions. The median was atrophied to less than half its normal diameter, below the elbow, and the ulnar nerve showed bulbous enlargements, with atrophied intervals. The wrist and hand were now easily straightened. The skin was closed, and the forearm was drained in several places with strands of silkworm gut. Sterile olive oil was poured over the tendons. The dressings consisted of aseptic gauze next to the skin over which was placed an abundance of iodoform gauze. A plaster-of-Paris cast was then applied and the hand and fingers placed in hyperextension.

The operation was completed in one hour and fifty minutes. Anæsthetics, chloroform and ether. Pulse before operation, 70; during, 108; and after, 88. Hypodermoclysis of normal salt solution at conclusion of operation (500 c.c.).

Results.—Union of skin by first intention. Chromoform catgut No. O, not absorbed in three weeks.

Report Six Weeks Later.—1. Tenderness in elbow is fast disappearing and flexion and extension are almost complete.

2. More vital activity is gradually coming into the hand.

3. Can immediately tell which finger is touched, showing a return of sensation.

4. Can pick up a small article, like a pin, after trying for a while, showing a return of muscular sense and coördination.

5. Fingers can be straightened and flexed to a considerable extent, and this power is increasing.

It is well to point out that the fracture was of the humerus, and the tight bandaging was on the forearm; the fracture united perfectly, and no damage was done to any of the soft structures surrounding it, but where the bandages were too tightly applied, atrophy, contraction and paralysis of the soft structures ensued.

In regard to fixed state in which the nerves were found, one can readily imagine how easily they could be ruptured by forcible extension of the fingers under an anæsthetic, and irreparable damage done.

The last report was in November, 1904, a year after the operation. Then she had all the motions of the elbow, forearm, wrist, and fingers almost complete, but not as strong as formerly. Sensation had returned to normal apparently, and she can readily distinguish between heat and cold. She no longer burns her fingers. If another case of this nature presents itself for treatment, I should rather choose to resect the bones than splice the tendons. Although the forearm would be shortened, the hand, etc., would be stronger. The tendons and nerves should always be liberated, and I think oil used.

Literature.—Volkmann was the first surgeon to write on this subject and to point out the dangers to muscle following tight bandaging, too-firmly applied splints and Esmarch's bandage too long in use. The damage done by these means became known as "Volkmann's paralysis," "ischemic paralysis," "ischemic atrophy," etc. Inasmuch as the muscles with their tendons and the nerves are the chief structures involved, the title of my paper "Ischemic Muscular Atrophy, Contractures and Paralysis," may not be inappropriate. The older physiologists conducted some experiments on the influence on muscles when the arteries were tied,—*i.e.*,

giving rise to paralysis. Hallen (1766), Stetson and Lesser. Kuhne concluded (*a*) loss of irritability, (*b*) paralysis of the muscle, and (*c*) rigor of the muscle, to be due to inhibited nutrition.

Carl Ludwig proved that rigor mortis, death of muscle, giving rise to paralysis. Haller (1766), Stetson and Lesser. was due to lack of oxygen.

Kraske has shown that muscles cannot stand the complete absence of the arterial blood current for six hours (Bernays).

The histologic changes have been studied by Keidelberg, Kraske, Lesser, Bernays, Batton, and others. Metchnikoff and Soudakewitsch established the fact that muscular atrophy in the strict sense of the word should be ranged under the group of phenomena caused by phagocytes (collateral).

Fortunately cases of ischemic atrophy and paralysis are rare. In 1888, at the German Society of Surgeons, held at Berlin, it is reported that Lesser saw seven cases; Bardenheuer, four; Helferich, three; and Konig, seven cases.

Dr. A. C. Bernays, of St. Louis, Missouri, published an able and excellent article in the *Boston Medical and Surgical Journal,* May 21, 1900, "On Ischemic Paralysis and Contracture of Muscles," from which I have extracted some of the data in this production. He does not report any of his cases, but makes mention of them. The first seven references here given were compiled by him.

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[16] Lemoine. Lyons Medical, Lyons, Dec., 1891, reports the case of a man in whom atrophy of the deltoid biceps, triceps and supinator longus muscles was caused by the compression of a strap used for carrying parcels. (For collateral study.)
[17] Littlewood. Letter to Lancet, Jan. 5, 1901, expresses the opinion that the term "ischemic paralysis" is a misnomer, the contraction occurring after elbow injuries in children being really due to the contraction of cicatricial tissue, the result of laceration of the flexor muscles. A swelling in the upper portion of the flexor muscles of the forearm has been present in all cases which have come under his notice. Splint pressure and splint sores are in no way related to the production of the deformity. (I Year-Book, Goul, 1902). (For collateral study.)

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, January 10, 1906.

The President, Dr. GEORGE WOOLSEY, in the Chair.

OPERATION FOR EPITHELIOMA OF THE HEEL.

DR. CHARLES L. GIBSON presented a man, 58 years old, who ten years ago had his left leg amputated below the knee for a condition which he was told was a cancer.

The lesion on the right heel was first noticed about a year ago. It appeared as a scaling of the heel, and then became papular. When Dr. Gibson saw the patient, in the summer of 1905, there was an ulcerating lesion of the right heel, about two and a-half inches in circumference. It proved to be an epithelioma. Dr. Gibson performed an atypical operation, which consisted in a removal of an oblique wedge of the posterior portion of the os calcis, together with the tumor. The tendo achillis, which had been divided, was lengthened by splitting it downward from the middle of the calf, and nailed to the lower end of the sawn surface. An autoplastic flap, designed eventually to cover the bone was now made by reflecting the skin towards the popliteal space; another flap was detached from above downward, and the free ends were sutured together. It was intended eventually, after firm union had taken place between these two flaps, gradually to sever the pedicle of the upper flap, when this whole flap would be turned downward and the free end sutured to the lowest level of the defect of the heel.

Unfortunately, there was not enough circulation in the extremity to warrant such a procedure, as the flaps failed even to unite.

The defect was subsequently remedied in part by skin grafting on several occasions.

Such an autoplastic operation had the patient's circulation been suitable, should have been very efficient, and in a suitable case is to be recommended. The wound is not quite healed, but the patient already has considerable use of the limb.

DR. GEORGE WOOLSEY narrated the history of a case where epithelioma developed at the site of an old ulcer of the leg, at the junction of the middle and lower thirds; the growth was thoroughly excised, and skin-grafts applied. The operation was followed by an early recurrence. Another surgeon then performed a similar operation with a like result, and the leg finally had to be amputated.

SARCOMA OF THE NECK TREATED BY MEANS OF THE MIXED TOXINS OF ERYSIPELAS AND BACILLUS PRODIGIOSUS.

DR. WILLIAM B. COLEY presented a man, 32 years old, who was referred to him on October 17, 1905, by Dr. Arpad G. Gerster, as an inoperable case of recurrent, small, round-celled sarcoma. His family history was good. His personal history was as follows:

In about the middle of August, 1905, he noticed a swelling on the left side of the neck, just behind the sterno-mastoid muscle, At about the same time he also noticed an enlargement of his left tonsil; there was no pain at first, but as both tumors increased rapidly in size, they soon became painful. In the latter part of August, 1905, the patient was operated upon at St. Mark's Hospital by Dr. Carl Beck, who made an attempt to remove the tonsil tumor, as well as that of the neck, he found it impossible, however, to make a complete excision. The patient was immediately put upon the X-ray treatment every other day, and also received radium treatment externally and internally; the latter, however, had little if any influence in checking the rapid growth of the tumor. On October 13, while under the care of Dr. Goldwater at the New York Polyclinic, a portion of the tonsillar tumor was removed and examined by Dr. F. M. Jeffries, Prof. of Pathology and Director of the Pathological Laboratory of the New

York Polyclinic, and also by the Practitioner's Laboratory, both of whom reported the tumor to be a small, round-celled sarcoma. On October 17, when Dr. Coley first saw the patient, physical examination showed the following condition:

The left side of the neck was occupied by a globular tumor, about the size of half an orange; it extended from the angle of the jaw in front, to the mastoid process behind, and downwards nearly to the clavicle. Its consistence was about the same as that ordinarily found in round-celled sarcoma; the skin was not adherent. Examination of the left tonsil showed it to be enlarged to double its normal size. The patient's general health had been but little affected. He was admitted to the General Memorial Hospital on October 17, 1905, and immediately put upon the mixed toxins of erysipelas and bacillus prodigiosus, without any other treatment. Daily injections were given, alternating, one day into the tumor direct; the other, into the pectoral region. The highest dose given was seven minims. His temperature ranged between 99.5° and 103°. In less than a week there was decided decrease in the size of the tumor, and an increase in its mobility. The diminution steadily continued and at the end of six weeks, both the cervical and tonsillar tumor had apparently entirely disappeared. The patient was shown before a meeting of the Harlem Medical Society on November 25, 1905. He left the hospital at the end of seven weeks, and although there were no visible remains of the tumor, the toxins had been kept up twice a week in the pectoral region, as a prophylactic measure against further recurrence.

It was interesting to note that the toxins used in this case, prepared by Dr. B. H. Buxton, of the Loomis Laboratory, were eight months old.

Dr. Howard Lilienthal said that some weeks ago he had seen the case reported by Dr. Coley, and at that time there was considerable brawny infiltration present, which he supposed was due to the injections. This had now apparently disappeared, and the cure seemed, for the present, at least, to be complete. The speaker said that while he did not favor the use of the mixed toxins in operable cases, he thought the remedy should always be resorted to in dealing with inoperable conditions, and as a postoperative prophylactic measure, especially in sarcomata of the spindle-celled

variety. He had every reason to believe that he had delayed and in some cases prevented the recurrence of these malignant growths by this method. In one case of cysto-sarcoma of the rib involving the pleura, in which only a partial excision of the malignant growth was possible, the injection of Coley's fluid was apparently followed by an absolute cure. Between three and four years had now elapsed since the operation without any signs of a recurrence.

Dr. Woolsey said that he had tried the mixed toxins, either alone or in combination with the X-rays as a prophylactic measure after operation, and thus far he had never seen much benefit in sarcoma of the round-celled variety. He mentioned the case of a small boy with a sarcoma in the carotid region. There were a number of recurrences, and after the growth had been removed for the fourth time the mixed toxins and X-rays were given as a prophylactic measure, but without any result. In the spindle-celled variety, the speaker thought the treatment offered a better chance of cure.

Dr. Coley, in closing, said that his earlier opinion, that most of the cures by means of the toxins were found in the spindle-celled variety of sarcoma, and that the toxins were but seldom successful in the round-celled variety, had not been borne out by the facts. His own cases, recently collected, showed of 34 successful cases, 16 spindle-celled, 12 round-celled, two mixed-celled, one epithelioma, and three in which no microscopical examination was made, although the clinical appearances, together with a history of recurrence, left little doubt as to the diagnosis. Of 56 cases treated successfully by other surgeons, 17 were of the round-celled, and 14 of the spindle-celled variety.

Dr. Coley said he believed very strongly in the wisdom of adopting the plan advocated by Dr. Lilienthal; namely, to use the toxins after operation in all cases of primary sarcoma as a prophylactic against recurrence. The speaker said he had done this in a considerable number of cases for several years, and he believed that in many instances the measure had prevented a recurrence.

FRACTURE OF THE FEMUR.

Dr. Royal Whitman reported the case of a boy who entered the Hospital for Ruptured and Crippled in September, 1905. Five weeks before he had sustained a fracture of the left thigh.

The limb was put up in plaster-of-paris by the family physician, and when this was removed, at the time of the boy's admission to the hospital, there was considerable deformity and shortening, and over-lapping of about 1½ inches. Under an anæsthetic after considerable manipulation and stretching, the fragments were brought into apposition, and a plaster-of-paris spica bandage applied, together with traction plasters, in order to prevent recurrence of deformity.

The bones united readily, and the boy now had a perfect limb. The chief point of interest in the case was the fact that the shortening of the limb had been successfully overcome five weeks after the receipt of the injury.

"THROMBOSIS OF THE MESENTERY."

Dr. Charles L. Gibson spoke of two cases of the kind that had come under his observation. The first one he saw with Dr. Blake about fifteen years ago. The patient was a man who had been an inmate of the hospital for some time with an inveterate syphilitic ulcer which failed to heal, and one day he suddenly developed an attack of complete abdominal obstruction. Upon opening the abdomen, the condition described by Dr. Hawkes was found, the section of the gut involved having been reduced to a soft, gelatinous mass. The patient promptly died.

The second case was also a man, who was admitted into the medical ward of the hospital with the symptoms of acute pyæmia. The abdominal symptoms, in the beginning, were not prominent. He had chills, and his temperature ranged as high as 106° F. There was a cardiac bruit, and the case was supposed to be one of malignant endocarditis. Subsequently, he developed acute abdominal symptoms, and on exploring the abdomen, the lower coils of intestine were found to be in this same gelatinous condition. That patient also died.

Dr. Gibson said the only suggestion he could make in the line of treatment was in a prophylactic way. We knew that this condition occasionally occured, and its possibility should influence the surgeon to handle the mesentery with the greatest respect in the course of intra-abdominal work.

Dr. Joseph A. Blake said that about a year ago a man entered the hospital from up the state. He had a fistula leading to

the small intestine, and gave a history of thrombosis of the mesentery, from which he had recovered. It was apparently one of those cases in which the circulation of the gut had not been completely cut off, and the surgeon in whose hands he fell did the very best thing under the circumstances, and made an artificial anus in the small intestine. According to a letter received from the operating surgeon, several feet of intestine were involved and the lesions in the mesentery and intestine were typical. The speaker said this was the only case he knew of which did not end fatally.

Dr. Blake said he recently saw a case of mesenteric thrombosis following an operation for appendicitis. The appendix was seven inches long. Following the operation, which was done towards the end of the attack, the wound became infected. This was relieved by taking out a couple of stitches. The patient's temperature then fell to normal, and remained so for five days and during that period there still remained slight abdominal pain and tenderness. The appetite was fair; there was some diarrhœa. The patient appeared to be getting well, when he suddenly developed acute symptoms of intestinal obstruction, and when Dr. Brewer opened the abdomen he found a gangrenous area in the ileum several feet from the ileo-colic junction, with adhesion to the abdominal wall, and a slight perforation. There was nothing to explain the condition unless it was a thrombosis of the mesenteric artery or vein, which had extended so as to cut off the circulation in this part of the intestine. A resection was done, but it proved of no avail.

Dr. Howard Lilienthal said he had seen several cases of mesenteric thrombosis following appendicitis operations, all of which went on to a fatal termination, but without the occurrence of gangrene of the intestine. The speaker said he did not know to what extent the mesentery was involved in these cases, but it was found, on operation, that it was thickened and œdematous, and obviously thrombosed. Dr. Lilienthal said that personally he had never seen any of these cases get well, but he recalled one case, a private hospital patient under the care of Dr. Gerster, who after a prolonged and severe illness finally recovered. During the course of his illness, the liver became swollen to such an extent that hepatic abscesses were suspected, and the suggestion to

FIG. 1.—Radiograph of normal and injured extremities taken July 10, 1904, two months after injury. Anteroposterior view.

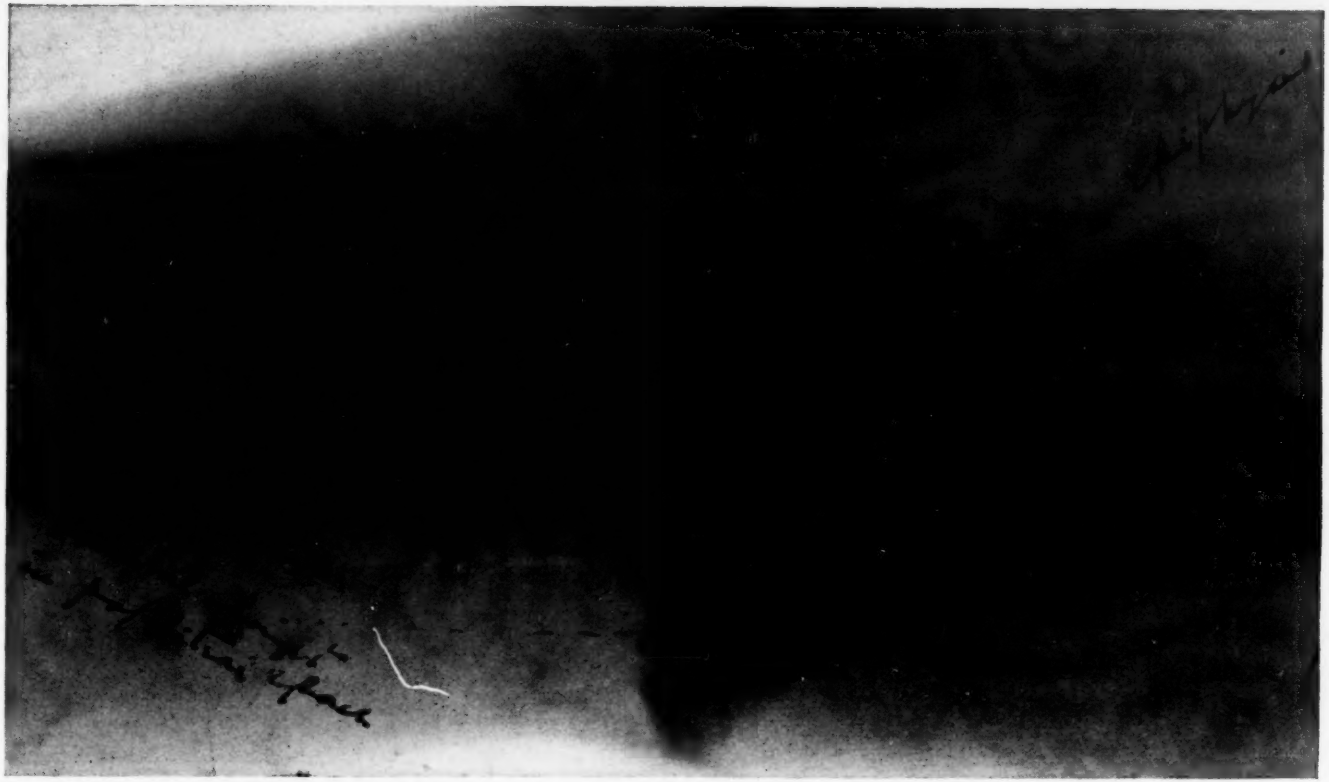

FIG. 2.—Lateral view two months after injury. (Note—The spots are plate defects.)

incise the liver was made to Dr. Gerster, but he refused to interfere, and the patient eventually got well.

In thrombosis of vessels of considerable size, gangrene was of course inevitable.

Dr. Hawkes, in closing, in reply to Dr. Lilienthal, said it depended to a great extent on the amount of mesentery that was thrombosed as to whether or not a collateral circulation could be established.

Stated Meeting, January 24, 1906

The President, Dr. George Woolsey, in the Chair.

OPEN OPERATION FOR SEPARATION OF LOWER FEMORAL EPIPHYSIS.

Dr. John A. Hartwell presented a boy, seven years old, who, on May 28, 1904, fell in front of a wagon, the wheel of which passed over his left thigh just above the knee-joint. He was taken to a hospital, and examination on admission showed every evidence of a fracture near the lower end of the femur. A few days later, under ether, the limb was put up in a plaster splint, in what was regarded as a favorable position to prevent shortening. This splint was left on for about a month, and upon its removal it was found that union in a faulty position had taken place.

Dr. Hartwell first saw the patient about this time, in the Second Surgical Division of Bellevue Hospital. An examination of the left lower extremity showed a shortening of over an inch, with the knee-joint practically immobile in a slightly flexed position. There was much thickening about the lower end of the femur, and the exact condition was not readily made out. The radiograph, however, showed the injury to be a separation of the lower femoral epiphysis, that fragment being dislocated on the anterior surface of the shaft of the bone, and riding upward for the distance of its thickness—*i.e.*, about an inch and a half. (Figs.

1 and 2.) The lower end of the upper fragment was thus forced down into the popliteal space.

On July 30, 1904, an incision about an inch and a-half long was made along the outer side of the knee-joint, extending from the head of the fibula upward. The incision was carried down to the bone, the joint structure being retracted downward, so that the joint, apparently, was not opened. The periosteum was then stripped from the lower end of the femur upward for a distance of about four inches from its anterior, external and posterior surfaces. The lower end of the shaft was found imbedded in the popliteal tissue, with the epiphysis completely separated from it, and lying directly on its anterior surface, with the condyles looking forward and downward. The separated surface of the epiphyseal end was thus in close contact with the anterior surface of the lower end of the shaft, to which it was united by a firm callus. By the use of a large carpenter's chisel, a few blows of the mallet separated the two fragments, and then, with blunt, flat instruments and curved hooks appli to the two fragments, the epiphysis was gradually slid down to its normal position against the lower end of the shaft, where it rested with very little tendency to a recurrence of the deformity, the surface of the condyles now looking in the normal direction.

It was now possible to flex the leg on the thigh well toward a right angle without dislocating the fragments, showing that the interference with mobility had been removed. The periosteum and other soft parts were then sutured in position and a moderate-sized drain inserted down to the bone, and a copious sterile dressing applied. The joint was believed to have been unopened. A plaster splint was then applied with the leg in the extended position, including the whole lower extremity, with the pelvis.

The subsequent convalescence was by no means satisfactory. The superficial wound became infected rather severely, which kept it open for several weeks. The infection, fortunately, did not seem to lead down to the bone, and at no time was there any evidence of involvement of the joint in this process. The wound healed slowly by granulation; at the end of five weeks it had completely cicatrized, and union of the bony fragments was complete.

Owing to the presence of the suppuration, and fearing that the process had interfered with bony union, no attempt had been made up to that time to bend the joint, so that it was then firmly fixed in an extended position. Under ether, the knee was flexed seven weeks after the operation, and about three weeks after the cessation of all suppuration. The trauma inflicted by this manipulation again started up the suppurative process, necessitating extensive incisions on both sides of the joint. The acute symptoms subsided rapidly, and a short time afterwards a very small fragment of bone was discharged, showing that the original process had undoubtedly communicated with the bone at some point. The wound then healed by granulation (and on December 3, when the boy was about to be discharged, he contracted erysipelas at the site of a small abrasion over the middle of the left tibia. This responded readily to treatment, and he left the hospital ten days later, five months after the original operation.

In spite of the infectious complications that had occurred, no serious damage had resulted to the bone or the knee-joint, the latter having been without any restraint since the removal of the splint, five weeks after the operation. While no attempt had been made to limber the joint by passive manipulation, the patient had been encouraged to use it as much as possible.

The following note was made upon the condition of the joint on January 4, 1905: The contour of the left knee was uniformly enlarged, the enlargement being slightly more marked on the internal aspect. Extension could be carried to within about 30 degrees of the normal, and flexion to about two-thirds of the way to a right angle, the arc of motion being about 30 degrees. The left lower extremity, in as full extension as possible, measured, from the anterior superior spine to the internal malleolus, 22 inches. The right extremity measured the same in the same position. The circumference of the left knee was eleven inches; of the right, ten and one-eighth inches.

On March 7, 1905, the length of both lower extremities had increased by half an inch, and the patient's total height was forty-five and a-half inches. The left knee could be fully extended, and flexed to a right angle. The patient walked without limping.

On January 8, 1906, the right lower extremity, as taken above, measured twenty-three and three-quarters inches; the left the same. The patient's total height was forty-seven and a-half inches. The knee could be flexed to about 30 degrees beyond a right angle, and extension was complete. The anatomical landmarks about the knee seemed to be in a normal relation. (Figs. 3 and 4.) Thus, in one year since his discharge from the hospital, the patient's lower extremities had each grown one and three-quarters inches, showing that there was no impairment of growth as the result of the injury to the lower femoral epiphysis, and the mobility of the joint had become about normal.

Dr. Hartwell said the interest in this case did not attach to its rarity, as more than one hundred cases of this injury are reported in the literature, and all the epiphyseal separations, the one at the lower end of the femur is the most common. The rule, too, was to find the displacement exactly as was met with here. The interesting feature of the case lay rather in the fact that the displacement of the separated epiphysis was not corrected for more than two months after the accident, and that notwithstanding this fact, there had been no loss of growth of the injured limb.

Scudder, in speaking of this injury, made the following statement: "If the epiphysis is separated without great laceration and periosteal denudation, and is replaced soon after the injury, the chances are that there will be a minimum amount of shortening." Stimson also speaks of the liability of the arrest of growth, though with proper correction of the displacement this is not the rule. The great resistance to any interference of the growth was well illustrated in this boy, where the original trauma was very severe, where replacement was so long neglected, and where extensive suppuration took place immediately at the site of the fracture line, if not actually involving it.

Dr. Howard Lilienthal said he had never seen a case like the one reported by Dr. Hartwell, in which there was separation of the lower femoral epiphysis. In dealing with such a condition, it was certainly a serious mistake to regard it as a fracture, and simply put the limb in a plaster splint. The result in Dr. Hartwell's case was excellent, and evidently the growth of the limb

FIG. 3.—Radiograph taken Jan. 8, 1906, eighteen months after operation, showing normal position of epiphysis. Anteroposterior view.

FIG. 4 —Same as Fig. 3. Lateral view.

had not been interfered with, in spite of the delay in correcting the deformity and the suppurative process that complicated the boy's convalescence.

PERINEAL PROSTATECTOMY.

Dr. Charles L. Gibson presented three men who had been subjected to perineal prostatectomy within the past four to six weeks, and who were aged, respectively, 84, 63 and 59 years. In each case the wound was healed, or practically so, the control was perfect, there was no residual urine and no cystitis.

Previous to adopting his present technique, Dr. Gibson said, he had been dissatisfied with his results by any of the methods, suprapubic, and combined suprapubic and perineal, with or without the formal exposure of the prostate by a transverse dissection of the perineum. In the last two years he had had no mortality, although many of his patient were far from good risks.

With regard to the technique used, Dr. Gibson said it had been as follows on all cases operated on for the past two years: An external urethrotomy was performed, then, in some cases, particularly stout individuals. Young's tractor was introduced, while, in thin persons, suprapubic pressure sufficed. Then, after division of the recto-prostatic septum or the recto-urethralis muscle with the scissors, the prostate was enucleated in one of three ways: (*a*) In toto, as in Case I, being very easily shelled out of its surroundings; (*b*) the lateral lobes were peeled off of the urethra by beginning the enucleation behind the prostate, and working from behind forward; (*c*) piecemeal extraction was adopted in dealing with very large growths, working from the urethrotomy opening towards the periphery or capsule.

Dr. Gibson said that in none of these operations had hæmorrhage ever been a serious factor, nor had there been any damage to the rectum. Drainage was provided by a large rubber perineal tube, well surrounded by sterile gauze packing. The tube was removed at an early date, and the patient was allowed to leave his bed in eight days.

Dr. Parker Syms said that the method described by Dr. Gibson was essentially the one which he had employed in all excepting his first case. He makes a median perineal incision

and reaches the prostate, as suggested by Alexander, through an incision in the so-called prostatic sheath. He always exposes and recognizes the sheath and prostate by sight.

The speaker said that while all enlarged prostates may be removed by this method, yet in some cases, enucleation will be much easier than in others. In one recent case he removed the prostate in a single piece, and the procedure had occupied but a few moments, but after the tube was removed, the patient had been unable to pass urine on account of papillomata which were just within the bladder neck. These had to be removed a few days later. This shows that one should very carefully explore the bladder orifice.

Speaking of the after-treatment of these cases, Dr. Syms said he always removes the tube at the end of forty-eight hours, and that he always gets the patient out of bed at that time, unless there was some special reason for keeping him there longer.

In the final healing of these wounds, he had often met with considerable difficulty, especially during the later weeks. This seems to be due to the fact that the healing proceeded from without much quicker than from within, with a tendency toward pouch formation.

Dr. Syms said that his results from perineal prostatectomy had been most satisfactory, and it was only in exceptional cases that complications arose. He regarded the perineal method of approach as the most simple and direct; it involved the least number of important organs and gave the patient the most rapid and safe convalescence.

Dr. Syms said the so-called method of Young, so far as the exposure of the prostate was concerned, was first described by the French surgeons, Albarran, Proust, and others; and that this method of exposing the prostate had resulted in the formation of more rectal fistulæ than any other. In the elaborate dissection that it required, one was very liable to wound the rectal wall.

Dr. Hotchkiss said he was glad to see the results in Dr. Gibson's cases of perineal prostatectomy, because he had felt for a long time that the perineal operation done through a small median perineal cut, and largely by the sense of touch instead of

sight, was for some reason less liable to be complicated by accidental injuries of the rectum, and the consequent fistula, than some of the more elaborate methods of exposure by the curved transverse incision, and dragging down the prostate by a metallic tractor within the bladder. In fact, the only case in which a rectal fistula had resulted in his own practice was in one where such an incision and a careful exposure of the tumor was made. He had first done the operation through the median perineal incision in 1896, enucleating the prostate easily with the finger by finding the planes of cleavage on either side of the urethral incision.

Dr. F. Kammerer said he always did the perineal operation, and in only one instance had he met with the accident of wounding the rectum. He usually made the curved incision across the perineum which he did not think added to the difficulties of the operation, as it usually enabled him, within a very few minutes, to get down to the prostate when assisted by the left index in the rectum. He considered it wise to lay open the field of operation for inspection. In the case where the rectum was wounded the patient had been improperly prepared and the rectal pouch in the wound was filled with fecal matter, a rupture occurred before the patient was fully anæsthetized and was vomiting, while a blunt retractor was depressing the rectum and anal region.

Dr. Lilienthal said he had never heard of a rupture of the rectum occurring in the course of a suprapubic operation on the prostate. He thought it only fair that something should be said in favor of that operation. Unlike the perineal method, it never, so far as he knew, resulted in a loss of sexual power, whereas it was well known that many of the perineal operations were followed by total loss of sexual power. He mentioned one case, a man 74 years old, where the suprapubic operation on the prostate was followed by increased sexual power.

Where the perineal operation was contemplated, it was absolutely essential that a preliminary cystoscopic examination be done. This was unnecessary with the suprapubic method, which afforded a perfect view of the interior of the bladder.

An injury to the rectum, which occasionally occurred in the course of a perineal prostatectomy, might not manifest itself for several days, when the rectal tissue sloughed out, leaving a rather hopeless state of affairs. A number of such cases had been

reported. If the accident was discovered at the time of the operation, the perforation could be sutured, but after sloughing occurred, that was out of the question.

Dr. Lilienthal said he had very recently done his thirty-ninth suprapubic prostatectomy. The operation, which was entirely successful, was completed in ten minutes. Of the thirty-nine cases, two died. Those that recovered were able to urinate as well as ever. In all of them, the syphonage method of draining the bladder was employed.

The speaker thought that while in some hands the perineal operation might be preferable to the suprapubic, he had no reason for feeling dissatisfied with the latter. The operation, if properly done, should give a very small mortality. The method possessed peculiar advantages in dealing with very old or feeble individuals who were bleeding. In such cases the bladder could be opened from above in a few minutes, and packed, and then the actual prostatectomy could be postponed for a week or longer, if the patient's condition indicated the wisdom of delay. Such a two-stage operation could not be done through the perineum.

In reply to a question as to the grounds upon which he based his assertion that the sexual powers were preserved by the suprapubic method, Dr. Lilienthal said he did not know. He simply knew from his own experience and from that of others that the sexual power was not impaired by the suprapubic operation, while the loss was comparatively common after the perineal method, even in young men who had been operated on through the perineum for the relief of a prostatic abscess.

Dr. F. Tilden Brown said he agreed with Dr. Gibson that it was of decided advantage, whenever possible, to complete the operation without traction, as it relieved one of the dangers of the metallic tractor, which was very liable to tear through the vesical mucosa. At the same time, there were a certain number of cases in which it would prove extremely difficult to effect enucleation of the enlarged prostate without other aid than suprapubic pressure. In certain instances of that kind, Dr. Brown said, he has found that pressure through the rectal wall with the gloved hand was very satisfactory.

The speaker said that the position advocated by Dr. Gibson, namely, elevation of the pelvis and hyperflexion of the thighs,

was a very important feature of the operative technique. The possibility of injuring the rectal wall was minimized by keeping the patient in this position, and by following the technique of Young and recognizing the landmarks, keeping close to the bulb, with the full understanding that this bulb, on its posterior surface, rises right up to the membranous urethra. The preliminary injection of a 1-1,000 adrenal solution added much to the satisfaction and ease of the dissection, as it obviated the necessity of mopping away the blood or working in the dark with the finger.

Dr. Gibson, in closing, said that his personal experience with suprapubic prostatectomy had been very unsatisfactory, and for that reason he had abandoned it. In regard to the question of the possible loss of sexual power after the perineal method. he looked upon it as a kind of bugaboo which might well be disregarded. Prostatectomy was a life-saving measure; not one of expediency, and the question of saving the sexual power in this class of patients was of secondary importance.

DISARTICULATION AT HIP FOR SARCOMA.

Dr. C. A. McWilliams presented a man, 23 years old, who was operated on in February, 1900, by Dr. Charles K. Briddon at the Presbyterian Hospital. The family history was unimportant. There was no specific history, but three years prior to admission, the patient had been operated on for inguinal adenitis following chancroids. Seventeen months prior to admission he had sustained a slight injury to the right knee. Nine months later he noticed slight pain and swelling in the right knee; this slowly but gradually increased in severity extending a little above the knee. During the last month, the growth had been more rapid. There had been only occasional pain at night, and the patient had been able to work up to within two days.

At the time of his admission to the hospital, the patient was poorly nourished and anæmic. The left posterior cervical glands, both axillary, both epitrochlears and both inguinal chains were palpable. The right inguinal glands were larger than the left. In the right iliac fossa there was a mass the size of an English walnut, just above Poupart's ligament; it was not tender, it moved freely over the deeper parts, and the abdominal wall was

freely movable over it. Apparently, it was an enlarged gland. There was a scar, three inches long, in the right inguinal canal, showing the site of the previous operation.

The lower end of the right femur was much enlarged, being three and a-half inches larger in circumference than its fellow at the same level. The swelling was hard and slightly tender; the skin over it was freely movable; there was no redness nor inflammation of the skin. The tumor was firmly adherent, and incorporated v 'th the femur. Flexion of the right knee was possible to the extent of 80 degrees.

Operation, February 5, 1900. A section was removed from the growth on the outer side of the limb, and by frozen section showed sarcoma. A disarticulation of the hip was then made by Wyeth's pin method. The patient made an uninterrupted convalescence, and left the hospital on the twenty-second day after the operation. There were no signs of a recurrence at the present time, a period of almost six years.

The pathologist, Dr. Thacher, made the following report: "Sections from the projecting part of the tumor, which was not calcified, showed a connective-tissue growth rich in spindle-cells, arranged parallel in strands, with a moderate amount of fibrinous, intercellular substance. Diagnosis, fibrosarcoma."

TUMOR OF THE PAROTID.

Dr. F. Kammerer presented a man, 55 years old, who was operated on four years ago for a carcinoma of the right parotid gland. The tumor soon recurred, and when the patient next came under Dr. Kammerer's observation, in May, 1905, there was a growth about the size of an adult fist, involving the right side of the face and the corresponding ear. It was questionable whether the case was operable or not, but it was finally decided to attempt it.

After ligating the external carotid, the incision was carried upward, and the growth removed as completely as possible, including the entire right ear, and the superficial layers of the mastoid process. Several enlarged lymphatic glands near the angle of the jaw were also excised.

Up to the present time, there were no signs of a recurrence.

A curious feature in connection with the case was that it was

impossible to locate the external opening of the right auditory canal in the cicatrix of the wound. The man was apparently able to hear as well on the affected as on the sound side.

"THE VALUE OF THE DIFFERENTIAL LEUCOCYTE COUNT IN ACUTE SURGICAL DISEASES."

DR. CHARLES L. GIBSON read a paper with the above title (for which see page 485).

DR. HOTCHKISS said that the value of the differential, and the uselessness of the ordinary leucocyte count as an indication of the real severity of a case, was strikingly illustrated in a case of acute phlegmonous cholecystitis a few days ago, where the blood-count showed approximately only 5,000 white blood-cells although the patient's temperature was 107, but the differential count showed 87 per cent. of polyneuclears. Immediate cholecystectomy was followed by recovery.

DR. LILIENTHAL said he had recently listened to a paper on this subject by Dr. Frederick E. Sondern, and since that time he had had a differential blood count made in practically all cases where the diagnosis was not absolutely clear at once, such as fractures, dislocations, and abscesses. He had found that, as a rule, the differential count was of decided value, and with the added advantage of the method described by Dr. Gibson, the difficulties surrounding the diagnosis and prognosis of certain obscure conditions should be still further overcome.

HYDRONEPHROSIS.

DR. GEORGE D. STEWART reported the following case: a girl, aged 17 years, was admitted to St. Vincent's Hospital, August 9, 1905, with the history that when ten years of age she was taken suddenly with nausea, vomiting, pain in head and back; the attack lasting for two weeks; similar attacks followed at irregular intervals, recurring, sometimes as often as once in two weeks After two years she went to the Presbyterian Hospital, where she was subjected to an operation and discharged after a month of treatment, her wound having closed. Two weeks after her discharge, she had another attack of pain, returned to the hospital, remained in bed two weeks and was again discharged. From that

time until her admission to St. Vincent's the attacks kept recurring. Shortly before an attack she noticed she was unable to void urine, and when the attack was over, often passed large quantities. On August 9, 1905, she was admitted to St. Vincent's Hospital suffering from an attack of appendicitis. On the 14th of August her appendix was removed through an inter-muscular incision and the wound was closed without drainage. The appendix was found to be acutely inflamed. She made an uninterrupted recovery. On January 10, 1906, she was readmitted to the wards of St. Vincent's. During the interval since her last operation she had been working in the laundry of that institution. Had had occasional attacks of pain located higher in her abdomen, and neither so frequent nor so severe as those from which she suffered in the summer. On admission she had a temperature of 100.6, pulse of 96, respirations 24; complained of soreness under the right costal border. Examination in this region revealed a large, tender mass, which felt much like a distended kidney. On the day of admission (she was admitted at 1 P.M.), at 5 P.M., she passed five ounces of urine, and at 12, midnight, thirty-two ounces at one micturition; afterward the tumor in the right lumbar region was found much reduced in size. The urine was clear, acid in reaction, gravity of 1011, showed a trace of albumen under microscope, many pus-cells, some blood-cells and much débris; leucocytosis 13,600. Examinations of urine made from day to day showed little variation from the above. No tubercle bacilli could be found either by staining or by inoculation of the guinea-pig. There was present, however, an acid-fast bacillus of unclassified origin. Cystoscopic examination was made by Dr. Keyes, Jr., who reported pus coming from the right ureter and clear urine from the left. No radiographic examination was made. On the 19th of January, the usual lumbar incision for exposing the kidney was made. The kidney was easily exposed, its posterior surface was found markedly adherent to the lumbar fascia, it was three inches below its normal level, the pelvis was very much dilated. The inner surface of the dilated pelvis reached to and beneath the inferior vena cava, the lower border to and over the pelvic brim. In attempting to loosen the kidney from its adhesions, the thin kidney-tissue was torn, and the contents were spilled; as far as could be observed they consisted of

fairly clear urine. In view of the previous operation, of the fact that ner left kidney was competent, of the distortion of the pelvis of the right kidney and the difficulty of making any plastic operation which would restore the continuity of the ureter and pelvis, it was decided to remove the right kidney. By very careful dissection the inner margin of the enlarged pelvis was separated from the spermatic vein and the inferior vena cava, the former resting directly upon the latter. After the separation was complete, the renal vessels were tied and here again great care was necessary, as the right renal vein was certainly not more than one-half an inch in length, and any tension on the kidney disturbed the course of the vena cava. The ureter was then ligated at about the pelvic brim and the kidney removed. The patient made an uninterrupted recovery, passing between thirty and forty ounces of urine the days following the operation. An examination of the urine on the 23d showed a normal secretion, except that there were some blood-cells and a few leucocytes present. Examination of the specimen shows that the ureter joins the dilated pelvis on its posterior aspect about two inches from the most dependent portion of the pelvic sac; the ureter turns almost directly upwards for about a quarter of an inch, and then downwards, so that the two limbs of the loop are parallel. At the summit of the loop the calibre of the ureter was considerably narrowed, elsewhere it was absolutely normal.

After the presentation of this case Dr. John Hartwell recalled the case as one in which a nephrorrhaphy had been performed for hydronephrosis.

Dr. Kammerer said that as there was a fair amount of kidney substance left in the specimen shown by Dr. Stewart, he thought an attempt at correction would have been justifiable, although he admitted that in the only well-pronounced case that had come under his care, he had removed the large sac, the walls of which evidently still contained a small amount of active renal tissue. But so much favorable testimony had been given by competent observers for the plastic operations on pelvis and ureter in these cases that he thought they should be tried when a fair amount of kidney substance still remained.

Dr. Ellsworth Eliot said that every effort had been made at the Presbyterian Hospital to find the early history of the case

reported by Dr. Stewart, but it had apparently been carried away by some one for reference, and had not been returned. The speaker thought that Dr. Stewart was quite justified in doing a nephrectomy in this case, basing his opinion upon an analogous case that came under the observation of Dr. F. Tilden Brown and himself in 1897. The case was one of intermittent hydronephrosis which was originally operated on by Dr. Charles K. Briddon, who had opened and drained the dilated pelvis of the kidney. In spite of this free drainage, which continued for a number of weeks through a lumbar incision, the symptoms of urinary obstruction were not entirely relieved, and they persisted even after the introduction of a ureteral catheter into the pelvis, and allowing it to remain there. The recurrent kidney crises were finally relieved by a nephrectomy. Dr. Eliot thought that plastic operations on the ureter or pelvis in these cases were theoretical rather than practical.

Dr. Hartwell recalled a case of intermittent hydronephrosis in a child in which the symptoms were relieved by correcting the kink in the ureter and then anchoring the kidney. He was unable to say whether permanent relief followed the procedure.

Dr. F. Tilden Brown said he thought Dr. Stewart was not only justified in doing a nephrectomy but that he had adopted the only measure that would change the patient's condition from invalidism to perfect health. Leaving out of consideration the anatomical condition that was met with in the adhesions between the pelvis and the inferior vena cava, which had added to the difficultes of the nephrectomy and which would have rendered reposition of the kidney equally difficult and hazardous, the specimen showed that he had to deal with a large dilated pelvis and a small, angulated ureter. To have left the kidney under such conditions would only have proved a source of discomfort and danger to the patient and the speaker said he did not think that any plastic operation would have corrected the deformity.

Dr. Brown said that in a case that came under his observation last summer he exposed the left kidney and found a somewhat similar condition to that reported by Dr. Stewart, but it was not nearly so marked, and he was able to relieve the symptoms by turning the kidney so that the line of exit was

straightened. In the case mentioned by Dr. Eliot ureteral catheterization failed to relieve the symptoms.

EMBOLISM OF THE SUPERIOR MESENTERIC ARTERY, WITH GANGRENE OF THE INTESTINE.

Dr. Parker Syms showed the specimen in this case. The patient was a man, 54 years old, who was admitted to the Lebanon Hospital on January 17, 1906, for a swelling in the submaxillary region, which proved to be an abscess, and was attributed to diseased teeth. The abscess was opened, and the patient was ready to be discharged, on January 23, when he had a sudden attack of abdominal pain, general in character, which subsided without the use of an anodyne. He had a similar attack in the evening, and the following morning he was found dead in the bath-room.

The autopsy showed a chronic endocarditis, and an embolism of the superior mesenteric artery, with gangrene of a portion of the gut. There was no perforation; no peritonitis.

Dr. Syms said he thought the endocarditis was the chief cause of death, probably hastened by a certain degree of sepsis. He did not believe the abdominal lesions were the sole cause of death, because perforation had not taken place and it seemed as though the patient had died of sudden heart failure.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY.

Stated Meeting, December 1, 1905.

The President, Dr. D. A. K. STEELE, in the Chair.

COXA VARA.

DR. LOUIS A. GREENSFELDER presented a boy, aged 17, who two and a-half years ago first experienced a dull aching pain on the inner side of left knee and in the popliteal space, described as lasting about one-half hour. This recurred at irregular intervals, alleviated by long-continued immobility of the limb plus extended knee. Pain and limping for the first two or three minutes of walking. No other symptom, either local or general, noticed for about six months; then pain gradually ascended to the thigh, and in another six months—one and a half years ago—involved the left hip. The pain was sharp and cutting, intermittent, severe enough to compel patient to cry out. Shortening of the limb was now noticed sufficient to cause the patient to walk on the left toes and pad the heel with leather; at the same time, he found he could not separate his limbs widely; the left leg seemed fixed at the hip. Flexion of the thigh on the abdomen was also inhibited beyond a right angle. Atrophy of the hip region was now noticed by the patient and soon involved the thigh. Patient remained indoors a greater part of the time, and limping was pronounced. There was no tenderness, change in color, nor swelling noticed. The deformity and limp have remained stationary. Patient has led an outdoor life for the past six months, and is in splendid physical condition. There is a history of a slight

traumatism. He recalls having been kicked by a horse two and a-half years ago, at which time the knee pain first began.

When the patient is in the recumbent position the left leg is in a position of eversion, but there is neither flexion nor abduction. Real shortening is apparent. Left gluteal region is smaller than the right. No lordosis. No skyphosis. Gluteal fold not obliterated.

Measurements.—1. Distance from top of great trochanter to Bryant's line, left 1⅜ inches; right, 3⅜ inches. 2. Distance from anterior superior spine to malleolus, left, 35⅜ inches; right, 37⅜ inches. 3. Top of great trochanter is two inches above the Rose-Nelaton line. 4. Distance from anterior superior spine to sacroiliac synchondrosis, left, 8½ inches; right, 11½ inches.

The X-ray picture illustrates the bending downward of the neck of the femur to a horizontal level and a posterior bending of the femoral neck.

Dr. Greensfelder said that the cause of coxa vara may be due to late rachitis; juvenile osteomalacia; arthritis deformans. Frequently it is bilateral, and then it is associated with marked lordosis, simulating congenital dislocation of the hip. The disease occurs chiefly during the fourteenth and eighteenth years of the patient's life,—*i.e.*, the bone-growing period.

This patient was put to bed with a Buck's extension, which was continued for four weeks, with the internal administration of small doses of phosphorus; in the last two weeks massage and electricity have been employed. Limp and walk have materially improved.

Dr. Wallace Blanchard by invitation said that true coxa vara may be said to be characterized by a non-inflammatory softening of the neck of the femur, due to defective nutrition, and is accompanied or followed by a yielding to pressure and downward bending and torsion. In illustration he related the history of a case as follows:

The affection is bilateral and of the adolescent type. The patient, Mr. Geo. L., aged 21 years, is a native of Illinois. He belongs to a long-lived family and nothing that is pertinent can be found in the family history. He is slender and undersized. His height is five feet, four inches, and he weighs 130 pounds. His general health is excellent, and his habits are faultless.

He had diphtheria at the age of fourteen, and when convalescent a slight limp to the right became apparent, and from that time to the present there has been a steadily progressive shortening of the right leg. The right leg and thigh are markedly atrophic. The right gluteal crease lies one and one-half inches above the left. The right leg shows an adduction deformity of 30°, and a rotation out of 40°. The right trochanter is prominent, and over one inch above Nelaton's line. The flexion of the right thigh is restricted about one-third.

He wears a lift, one and one-half inches thick, under the right shoe, which just levels the pelvis. He habitually stands when in bare feet with the right heel elevated one and one-half inches from the floor. (Fig. 2). Measurements show that there is three-quarters of an inch of adduction shortening, and three-quarters of an inch of real shortening, as compared with the left leg:

In the left leg fifty per cent. of abduction is lost, and the trochanter major lies three-quarters of an inch above Nelaton's line, indicating a coxa vara bend downward of the neck, sufficient to reach a horizontal line, and giving approximately a real shortening of the left leg of three-quarters of an inch.

Since the real shortening of three-quarters of an inch of the right leg was found by comparing it with the left leg, which was already three-quarters of an inch short, it will readily be seen that the right leg has really a real shortening of one and one-half inches.

There has never been any pain or tenderness about either hip, except that prolonged standing produces a temporary feeling of soreness in the vicinity of the right hip-joint.

He walks with a decided limp to the right, nothwithstanding the lift of one and one-half inches under the right foot.

The patient has been under the observation of Dr. Blanchard for two years and the real shortening has increased somewhat in both legs, and the adduction deformity of the right leg has increased about 10° in that time. The case may therefore be considered as still in the progressive stage. He is employed at bookkeeping. He sits most of his working hours, and has to be on his feet only occasionally. He does not want to be hampered with extension hip splints, but is ready to submit to an osteotomy

FIG. 1.—Showing the bending down of the neck of the femur in Greensfelder's case of coxa vara.

FIG. 2.—Bilateral coxa vara.

FIG. 3.—Skiagraph of a case of coxa vara. Dr. Blanchard.

for the correction of the adduction deformity of the right leg, as soon as he can be assured that the disease has run its course and that the femoral necks have reached firm bearings.

The skiagram shows the head of the left femur to be depressed, so that the neck lies in a horizontal position, making a right angle with the shaft, while the head appears to have retained its full rounded shape.

Much more grossly abnormal conditions are shown by the skiagram to exist in the head and neck of the right femur. The extracapsular neck has an inclination downward of some 65° from its normal position, and the inclination downward gradually increases in the intracapsular neck, until it reaches an obtuse angle with the shaft.

This distortion of the neck has reversed the direction and dislocated the head of the femur over the lower rim of the acetabulum until only the upper margin of the head lies within the socket. The upper half of the head has lost its rounded contour, and the upper half of the acetabulum appears to be filled with adventitious material. (Fig. 3.)

Altogether, this skiagram is a very remarkable picture of distortion from the normal shapes and relations, in and about the right hip-joint.

The history of the case leaves little doubt that the deranged nutrition and consequent softening and loss of resisting power in the femoral necks and head is of post-diphtheritic origin, and seems to sustain the views of Köhler that "the deformity is of such kind that it can be explained by the mechanical pressure, and tension effects on bone of yielding character."

The importance of diagnosis lies in the fact that subtrochanteric osteotomy is very successful in relieving the adduction deformity, and restoring normal locomotion, when operated after the coxa vara has ceased to be progressive.

Dr. Edward H. Ochsner said these two cases represented distinct types of coxa vara. Of the various cases he had seen he should be inclined to class these two cases in two distinct groups. The one demonstrated by Dr. Greensfelder made the impression of being a case of coxa vara due to traumatism. There was a great deal of doubt about this subject yet; but in looking at the X-ray prints carefully, one could not fail to notice

great difference in the two specimens. In Dr. Greensfelder's case the neck had not suffered much in length; it was almost normal except that it tilted and was horizontal instead of being at an angle of 127°. There appeared to be less trouble also in the acetabulum.

In the other type of coxa vara, due to softening of the bone, there was usually marked deformity of the acetabulum, and accompanying that was a marked shortening of the neck. The bone looked as though it had been soft at some time and had been moulded during the soft period. The X-ray picture brought out this point very forcibly. All things considered, he was inclined to think traumatism had a good deal to do with the case reported by Dr. Greensfelder, while the one shown by Dr. Blanchard was evidently a case of static coxa vara.

Dr. Edwin W. Ryerson stated that from the normal position of the neck of the femur and normal acetabulum it would be reasonable to conclude that there was a separation of the head of the femur. He would consider it either a fracture or separation of the head of the femur and not a case of true coxa vara.

Dr. John L. Porter agreed with Dr. Ochsner that there were two distinct groups of cases, and in a large percentage of them, if studied carefully, there would be found a history of injury but oftentimes only a slight injury. He had been surprised at the cases in which separation of the epiphysis of the femoral head had taken place with very slight traumatism. He had seen a number of cases of this kind of deformity at the Cook County Hospital, and in almost all of them the ages were between twelve and twenty, most of them being young men. The history was that of slowly progressing disability, with marked adduction and a good deal of pain in the groin, or of slight traumatism followed by pain in the groin. While the patients thought they were practically well, there was always some limping and marked adduction. He mentioned the case of a farmer's boy, aged fifteen, who in loading hay used the thigh as a fulcrum for the pitchfork. The patient felt a sudden giving-way in the groin. He fell down. The pain was intense for a few minutes, but he was able to walk home a distance of half a mile. He remained about the house for a few days, until the pain and disability subsided, and went back to work a week later, and while plowing stubbed his

toe against a stone. The pain was so intense that he dropped in a furrow and had to be taken up and carried home. He was in bed three months, and an X-ray picture taken a year or more afterwards showed typical separation of the epiphysis of the head of the femur, with a bending downward of the neck, the epiphysis being caught above the acetabulum. Coxa vara was marked in this case. Adduction was marked, so much so that the only way to get the heel on the floor was by putting it over the other foot. Patient walked with marked limp. The more he studied these cases, the more carefully he looked for history of slight traumatism.

He had taken recently an X-ray of one of these cases within two days after the injury. The patient, a girl, thirteen years of age, in running about the house, bumped against a corner of a table or door, and experienced some pain, which lasted a few minutes, then passed off. She went about as well as she ever did for about forty-eight hours; then the parents noticed her limping, and she began to have pain in that hip. After making a tentative diagnosis of separation of the head of the femur, the X-ray picture showed a little gap at the line of epiphysis in the head, and by putting the leg up in extreme abduction and keeping it there, apparently she was getting well. The abduction was not limited.

He believed up to the time of the advent of the X-ray apparatus, surgeons mistook a large number of these cases for hip disease. Many of these cases of coxa vara had traumatic separation of the epiphysis, and he had been astonished, the more he saw these cases, at the small amount of traumatism which it took to separate tne epiphysis at the head of the femur during adolescence.

Dr. Daniel N. Eisendrath had seen the boy with Dr. Greensfelder, and concurred with him in the diagnosis of true coxa vara. He thought if the members studied the X-ray print carefully they would see that such a position was well taken. The condition was to be seen better in the print than on the plate itself. It was a rather unusual point for an epiphyseal fracture to occur. In the opposite limb, the left one, the epiphysis was at a point just back of the rotundity of the head. The X-ray showed a light shadow mixed with a dark one. This was the place where epiphyseal fractures ought to occur; but it would

seem rather unusual to have a fracture of the neck of the femur where a fracture of the epiphysis would be so much easier to take place.

Another point which seemed to him to confirm the diagnosis of coxa vara in this case was, that the head itself was flattened out. This showed that the head must be soft. Not only was the head softened and flattened, but there was compression or flattening of the lesser trochanter; so that the position taken by some of the speakers that the case might be one of epiphyseal fracture instead of coxa vara was not well taken.

DR. M. L. HARRIS said we should distinguish between two classes of cases, those which were static in their origin, and those which were traumatic. In the static variety there was a disproportion between the weight to be carried and the strength of the neck. This was known to be due to lack of strength in the neck, and there were several causes for it. The yielding was not only a gradual one, but it was more or less uniform. It never yielded at an acute angle of the length of the bone, but it was a uniform and gradual yielding. There was in almost all cases not only a yielding from above downward, but also from before backwards and there were evidences of weakness of some of the other structures. For instance, flatfoot was present in a large number of cases.

In the traumatic variety, while there was descent of the head and neck, many cases were not, strictly speaking, true coxa vara in the sense of being static. He could not agree with Dr. Eisendrath in regard to the interpretation given the skiagraph, as there was a distinct, sharply defined, marked angularity of the neck of the femur, a thing which one rarely or never saw in a case of true coxa vara. He also could not agree with Dr. Eisendrath that the epiphyseal line was the weakest point of the bone and that separation of the epiphysis occurred in preference to fracture of the bone. Epiphyseal separations are the great exception in comparision with fractures.

In these cases the bone yielded in preference to the epiphyseal line. The fact that the head was deformed was further evidence that there had been a traumatism and a fracture, causing the spreading-out of the head. The line next to the trochanter was something we did not see in cases of coxa vara. He believed

the case was distinctly one of traumatism to the head and neck of the bone and was not a true case of static coxa vara.

Dr. Wallace Blanchard could not agree with Dr. Eisendrath that separation should occur through the epiphysis. His experience in fractures close to the epiphysis was that they never occurred where they should. Of some eight hundred cases, of osteoclasis in two-thirds of which the epiphysis was under pressure, in only one was there separation of the epiphysis. If there was any opportunity at all, the fracture would occur outside and away from the epiphysis rather than in the line of the epiphysis.

In the skiagram of true adolescent coxa vara submitted by him a gradual bending would be seen,—not an abrupt bending, but a gradual giving-way, and this was what he called true coxa vara resulting from a non-inflammatory softening of the bone, gradual bending and giving-way without selecting any particular location or angle, or any one point of the bone.

Hoffa and many others had insisted that a large number of cases of coxa vara were of traumatic origin, but these were clearly proven to be of a different class. They were not true cases of coxa vara. He would not class the case of Dr. Greensfelder as one of true coxa vara, but rather as one of impacted fracture. He had seen cases in which the fracture started in the epiphysis, left the epiphysis, and went down the neck.

Referring to the case reported by himself, Dr. Blanchard asked whether there was a time when we could say to a patient we could do osteotomy, correct the adduction deformity, and assure him that another operation would not be required to correct another deformity which might occur from the further progress of the disease? Could we at any given time safely say to the patient when we operated, that this was the only operation that would be necessary?

SUBPHRENIC ABSCESS.

Dr. Daniel N. Eisendrath presented a patient upon whom he had operated for right-sided subphrenic abscess following appendicitis, with the following history:

Patient, an Italian, had been operated upon for an appendiceal abscess one year previously by some surgeon whose name he was unable to learn. The patient was admitted to the service of Dr. Eisendrath at Cook County Hospital, on September 19, 1905, with

a history of having had a severe pain in the epigastrium for one week. His temperature, upon admission, was 103°. There was an area of dullness extending almost transversely around the chest from the level of the fourth rib downwards, merging into the hepatic dullness. A needle was inserted in the post-axillary line in the sixth interspace, and fetid pus obtained. The sixth rib was resected in the post-axillary line, but the pleural cavity found empty. This operation was performed by one of the house surgeons under local anesthesia. When the case was first seen by Dr. Eisendrath, the patient had been having a high temperature for five days, so that a second thoracotomy was undertaken in the anterior axillary line, a portion of the eighth rib being removed, and an encapsulated empyema was found lying between the inferior surface of the right lobe of the lung and the upper surface of the diaphragm, the so-called diaphragmatic empyema. It was thought that this second operation would prove sufficient, but following it the patient's temperature continued to rise and he having become septic, a third resection was deemed advisable. This third operation was performed by resecting a portion of the tenth rib in the anterior axillary line, when a large subphrenic abscess containing about a pint of very fetid pus was opened. Following this drainage the patient made a rapid recovery.

The case was undoubtedly one of subphrenic abscess complicated by an encapsulated diaphragmatic empyema, the etiology of which was in all probability due to the suppurative appendicitis of the previous year.

MACROGLOSSIA.

DR. EISENDRATH exhibited a boy of four, whose tongue at the time of birth was so large that it protruded from the mouth. When first seen, about six months prior to his presentation before the society, the case having been referred by Dr Nance, the tongue was very large and its surface covered with innumerable pinhead-sized and somewhat larger vesicles containing a clear fluid. In addition there were a great number of papillary projections composed of hyperplastic epithelium, resembling somewhat an icthyosis hystrix of the skin in its appearance. The case showed a combination of the superficial or capillary and deeper or larger forms of lymphangioma.

The case was treated in a conservative manner by simply

cauterizing with the Paquelin cautery all of the superficial vesicles, instead of performing a radical extirpation of the entire lymphangiomatous area. The case had improved greatly since the time of the operation, and the tongue had become much smaller. He believed that this conservative treatment, the simple use of the cautery, was preferable in many cases to the risk of hemorrhage by resecting the diseased area.

DR. A. J. OCHSNER drew attention to a method which had been practiced by many surgeons of making a temporary ligature of the tongue by tranfixing it at its base with a needle, threaded with a double piece of silk, tied to each side, and then the portion which one desired to remove was excised, the vessels ligated, and the two sides sutured together, the stump finished, and the temporary ligatures removed, so that one could give the tongue any form desired without any risk whatever. It was a simple matter to do this. This treatment was rapid and satisfactory.

BRANCHIAL CYST.

DR. EISENDRATH also presented a patient from whom he had removed a right-sided branchial cyst about two months previously. When the patient first presented himself he had a soft, fluctuating swelling, located in the submaxillary region, over which the skin was freely movable, but it was attached firmly in its deeper parts. The patient was thirty-five years of age, and gave a history of having had the swelling for the past ten years, during which time it had been tapped a number of times. At the time of operation the cyst was found to be firmly adherent to the deeper structures. It had no connection with the pharynx. It was located in the angle between the upper end of the sterno-cleido-mastoid and the lower border of the lower jaw. It was about the size of an egg, and contained a yellowish turbid fluid, with cholesterin crystals. Microscopically, it showed a stratified epithelium corresponding to the mucous membrane of the pharynx as well as a number of mucous glands and lymphoid tissue, showing its origin had been from the pharyngeal end of the second branchial cleft.

FRACTURE OF THE UPPER END OF THE HUMERUS.

DR. EISENDRATH showed a patient with an impacted fracture of the neck of the humerus. The patient fell on the outstretched

hand. When first seen there was inability to use the shoulder, but no external deformity. There was slight crepitation, which was probably due to the fact that the impaction was an imperfect one. The exact nature of the injury was not determined until an X-ray examination had been made. This showed that the lower fragment had become impacted into the upper seat of the fracture, corresponding with the surgical neck of the humerus.

He had been unable to find any reference in books to this variety of fracture, with the exception of Hoffa's, in which a similar fracture was illustrated.

He demonstrated the use of moulded plaster-of-paris splints in connection with fracture of the humerus.

ADVANCED RAYNAUD'S DISEASE.

DR. EISENDRATH exhibited a case of advanced Raynaud's disease, in which amputation of one toe on the right foot and three toes on the left foot had become necessary on account of gangrene. The remaining toes still showed the bluish discoloration characteristic of this disease. The internal treatment had been of little avail to prevent the onset of gangrene. The patient had received nitroglycerine, 1/100 of a grain, three times daily, with a view to dilating the peripheral arteries several months while under the treatment of Dr. A. D. Kohn, by whom the case had been referred. This remedy had been combined with the application of a rubber constrictor, but both of these had but little influence in diminishing the pain or preventing the onset of gangrene.

He thought it was of great importance to recognize these cases early, both in the fingers and toes, the characteristic feature being a bluish discoloration which became more intense when the parts were exposed to the air.

"ISCHEMIC ATROPHY, CONTRACTURES AND PARALYSIS."

DR. ALEXANDER HUGH FERGUSON read a paper with the above title (for which see page 598).

DR. A. J. OCHSNER said that there was one point in connection with the subject of this paper which was under-estimated, and that was the possibility of producing tendons from almost nothing, tendons which would be useful to the patient. The worst

case he had observed, and he had seen many in which it was possible to produce tendons, was one in which the hand of a brakeman was caught between the bumpers of freight cars, sepsis ensued, and the extensor tendons were removed during the treatment of the septic condition. The patient came without any extensor tendons of his right hand. The ends were found the surface laid open, and artificial tendons were produced by means of chromicized catgut, varying in length from ten to fifteen centimeters. The man was willing to undergo this experiment without any promise of success. The man was still in the employment of the railroad company, and had a useful hand. The action secured in Dr. Ferguson's case by splicing the tendons was not surprising, and it made us more hopeful in tendon surgery.

BOOK REVIEWS.

SURGICAL DIAGNOSIS: A MANUAL FOR STUDENTS AND PRACTITIONERS. By ALBERT A. BERG, M. D., Adjunct Attending Surgeon to Mt. Sinai Hospital, New York. Illustrated with 215 engravings and 21 plates. Lea Brothers & Co. 1905.

In this book the author has departed from the conventional and stereotyped manual of surgery. He has blazed a new way in the maze of surgical facts and has presented them in a terse and lucid style to the student of surgery. Preceding the consideration of the diagnosis of each ailment, there is prefaced an epitome of the salient signs, symptoms and gross pathology of the malady. The methods of diagnosis as presented can no longer be called clinical in a classical sense, for the author is ever leaning on the crutch of the pathological laboratory on the one hand and the big stick of X-ray on the other to support an otherwise crippled clinical diagnosis. This is best exemplified in the teaching that the correct diagnosis of tumors of the breast commonly calls for exploratory incision and the use of the microscope, and the advocacy of the X-ray as a *sine qua non* for the diagnosis of fractures. In the matter of cystoscopy the author's enthusiasm has carried him too far when he gives the warm support to the teachings of Fenwick that ureteric meatoscopy alone offers pictures that are pathognomonic of the maimed and derelict kidney. The absence of any discussion on cystitis is commendable, for this disease is no entity; it is an end result of other pathological conditions.

The illustrations are very numerous and great thoughtfulness has been displayed to strictly conform to the text in the selection of them. They are borrowed for the most part and duly credited.

For several decades the greatest advances of surgery were

dependent on bacteriology, but the practical uses of the cryoscope, the esophagoscope, the sigmoidoscope, the hemoglobinometer and even the elicitation of new symptoms, as Head's Zones, McEwens signs and commotio thoracis (Perthe's disease), discussed in these pages, clearly point to the need of a sound training in physics for the physician and surgeon alike to keep abreast of the progress of surgery.

The subject is treated of in six parts. Part I refers to general considerations on diagnosis in three chapters, respectively devoted to the methods of diagnosis, clinical significance of general symptoms in surgical diseases, and surgical infections. A regional consideration of the injuries and diseases of the head and neck, thorax, abdomen and extremities comprises the contents of the remaining five parts.

MARTIN W. WARE.

DISEASES OF THE SKIN. By JAMES NEVINS HYDE, A.M., M.D., of Chicago, and FRANK HUGH MONTGOMERY, M.D., of Chicago. Seventh and revised edition. Lea Brothers & Co., Philadelphia and New York. 1904.

This work is a practical treatise on diseases of the skin for the use of students and practitioners. It is liberally and well illustrated. The plates in colors and monochrome are not especially good.

Most of the illustrations are from actual photographs and are well printed on heavy paper, giving to the reader a fairly accurate idea of the appearance of the disease.

The first part of the book is devoted to the anatomy and physiology of the skin and the general symptomatology, etiology, pathology, diagnosis, and therapeutics of diseases of the skin. The second part takes up in detail the disorders of the glands, inflammations, hemorrhages, hypertrophies, atrophies, new growths, sensory dermatoneuroses, and parasitic affections.

The important subjects of the technique and value in diseases

of the skin of both the Finsen light and the X-rays have been fully considered, not only in a special chapter, but also in connection with the treatment of the various disorders in which these measures have proved useful.

The work is in its seventh edition and has been carefully revised.

PAUL M. PILCHER.

GYNECOLOGY: MEDICAL AND SURGICAL OUTLINES FOR STUDENTS AND PRACTITIONERS. By HENRY J. GARRIGUES, A.M., M.D., of New York. J. B. Lippincott Co., Philadelphia and London. 1905.

The present work should not be confused with the Text-book of Diseases of Women by the same author which was published in 1900, nor with his Text-book of the Science and Art of Obstetrics published in 1902.

This volume is written especially for students in medical colleges and such general practitioners who desire to make themselves acquainted with the essentials of modern gynecology. It is but an outline, or guide to beginners, describing in detail the minor operations, and setting forth only the chief features of the major operations.

The most valuable part of the book is the general division which treats of the methods of investigation and examination of the patient and treatment in general. The special division which treats of the various departments of gynecology in detail, while complete as a guide to beginners, still is quite elementary and reflects the individuality of the author.

PAUL M. PILCHER.